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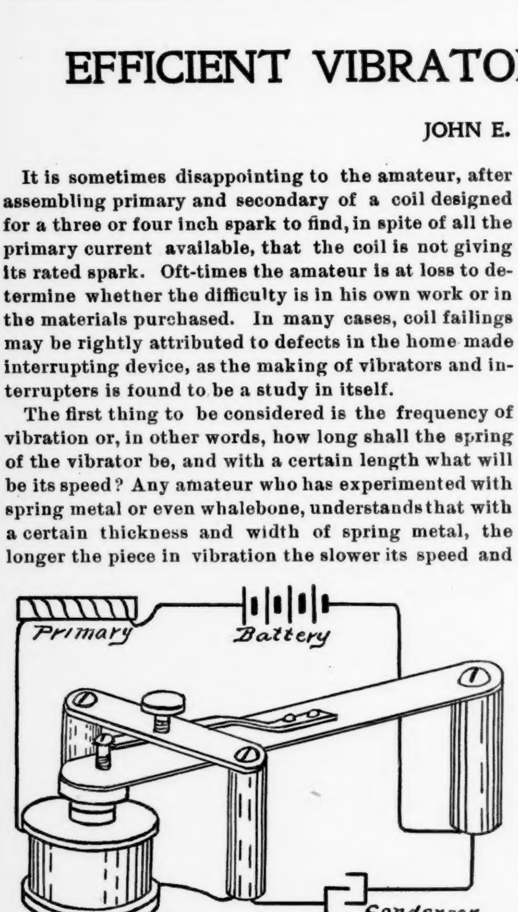
EFFICIENT VIBRATOR FOR SPARK COILS.

JOHN E. ATKINS.

It is sometimes disappointing to the amateur, after assembling primary and secondary of a coil designed for a three or four inch spark to find, in spite of all the primary current available, that the coil is not giving its rated spark. Oft-times the amateur is at loss to determine whether the difficulty is in his own work or in the materials purchased. In many cases, coil failings may be rightly attributed to defects in the home made interrupting device, as the making of vibrators and interrupters is found to be a study in itself.

The first thing to be considered is the frequency of vibration or, in other words, how long shall the spring of the vibrator be, and with a certain length what will be its speed? Any amateur who has experimented with spring metal or even whalebone, understands that with a certain thickness and width of spring metal, the longer the piece in vibration the slower its speed and



vice versa, the shorter the piece the faster it vibrates. Presuming that we have a piece of thin spring-brass in use as a vibrator, consider that the piece vibrates 700 times a minute. Then, with proper platinum contacts, the primary current is interrupted in its progress through the primary winding just 700 times each minute. Now 1-700 of a minute seems a very small period of time to measure, and it is at first difficult to perceive how any good can come from such a brief contact, and in the majority of vibrators using two platinum contact points, this is about the limit for maximum results from a winding, unless the secondary in use is wound for a much greater spark capacity and then underrated, which is, of course, a waste of fine wire. Small coils, such as ¼ to ¾-in. sizes, permit of a much faster vibrator, and on auto coils the speed is often 1000 and higher.

It must be borne in mind that the writer speaks of vibrating interrupters, and not of rotary and other forms involving other principles of interruption.

It will be found by experiment that there is a certain speed of interruption best suited for each coil, and with the assistance of the following description and diagrams the amateur should be able to get one-fourth to one-half more spark capacity out of any home-made coil, than where a core-actuated movement is brought about by a separate or independent electro-magnet in series with the primary winding.

The first requisite is a base-board of ½-in. stock, white-wood or mahogany, size 4 by 7 in. The electro-magnet is of ⅝ in. soft iron, 3 in. long, drilled and tapped at one end for an 8-32 machine screw by which the magnet is attached to the base board. The fiber washers are 1 in. in diameter. This magnet is wound with No. 20 double cotton covered wire. The vibrating spring is of No. 20 gauge steel or spring brass, ½ in. wide and 3½ in. long. The ham er head is of iron, ¾ in. wide and ⅜ in. thick, soldered or pinned to one end of the spring. The other end of the spring has a ⅛ in. hole for affixing to the standard by means of a long machine screw that passes through a hole in the standard through the base board, where it is held securely by a nut. The hammer head is now ¼ in. clear and above the top of the electro-magnet. The standard above mentioned is cut from a piece of ⅜ brass rod.

The contact-screw supports consists of a stout strip of brass rod affixed to two upright rods in a manner similar to the spring support. One platinum point is set into or soldered to the contact-screw. The other platinum point or stud is not soldered to the spring itself, but to a thin spring of brass riveted to the vibrating spring. (See sketch.)

The purpose of this method is to supply means of

giving an instantaneous break to the interruption The value of the ascendency spark depends considerably on this quickness of break. In operation, the hammer head is attracted toward the magnet and has travelled nearly a 64th of an inch, and is going very fast when the platinum spring is "kicked" by the stud borne by the vibrating spring, and released from the set-screw contact. This break is far superior to any other simple method and should be adopted for all home vibrators.

In making coil connections, one terminal of the magnet coil goes to the terminal of the primary winding. The other terminal of the primary is connected to the battery. The other side of the battery goes to the vibrator post. The second end of the magnet coil goes to the contact. (See diagram.)

The condenser to be used on this vibrator is connected, one terminal to the contact screw and one to the pillar post. The capacity of this condenser is ascertained by experiment. It is assembled, not by mathematical calculation as to micro-farads, but is built up until the condenser seems to produce the best secondary discharge. Every amateur knows that a condenser is necessary to get a spark, but not every one understands fully its functions. One thing is certain, by a careful adaptation of the condenser, the *best* secondary spark will be obtained when the platinum point spark is *almost* at a minimum. Too much condenser will reduce this contact point sparking to nearly nothing, to the detriment of the secondary results. It will therefore be seen that too much condenser is a harmful possibility; also a poorly constructed condenser is injurious and, furthermore, there never yet has been a coil vibrator of a reliable sort but there is some sparking at the points, and while this sparking in the laboratory is of little consequence, on a power boat or an auto it is a nuisance, and coil manufacturers look more to the efficiency of their vibrator, as regards minimum sparking and consequent non-welding of platinum contacts, than to any other detail of coil construction.

It is the writer's belief that the foregoing interrupter is applicable to almost any battery coil giving three and four inch sparks. The design furnishes excellent opportunity for adjusting the length of the vibrations by merely drilling long slots in the spring and in the base board so that the pillar-post may be brought nearer the magnet.

ACETYLENE GAS ENGINES.

J. K. RUSH.

Until recently it has not been practical to use acetylene for gas engines, owing to the fact that but very few acetylene generators generate acetylene at a temperature low enough to obtain a purity of gas or quantity sufficient to bring about the practical use of acetylene in an engine, but there are some generators producing acetylene of a sufficiently low degree of temperature to bring about a purity of quality and increase of volume of acetylene to such an extent that cooking and heating with acetylene has not only been made practical and profitable to many who are now using acetylene, but its use is now applied very practically to engines, which have been formerly used with gas and gasoline.

Of course, engines used for this purpose are especially constructed, owing to the fact that a much smaller quantity of acetylene is required, when properly mixed with oxygen, to bring about good results in an engine than is used when coal gas is applied.

An engine of this kind may be applied for running various kinds of machinery for factory purposes and the generator used for furnishing acetylene for heat, light and power. The heat may be used in the laboratory, the light for illuminating the entire premises, acetylene as applied to the engine, power for the entire institution—all supplied from one source.

The advent of the acetylene engine in the field of active industry will be a great boon to the trade generally, inasmuch as in many places acetylene generators will be purchased strictly for the sake of obtaining the gas for power purposes.

A country home or estate may now be fitted out with an acetylene plant, whereby the lighting of the buildings, as well as the grounds, is supplied from the machine, acetylene for heating and cooking purposes in the culinary department and hot water heating appliances in the bath room. The acetylene engine can be used for the purpose of forcing water through pipes in the most modern manner possible to conceive of, thus supplying the suburbanite with all the luxuries of city life so far as these particular items are concerned.

It is very interesting indeed to know the various uses to which acetylene is being applied. There is hardly a day at the present time but what some new application is made of this valuable combination of carbon and hydrogen.

We see it in use on all up-to-date automobiles, launches, bicycles and many other similar uses, where the very brightest and best results are desired by way of illumination.

Now, since the acetylene engine has come into the field, it would not be at all surprising to see within the next year at the automobile show, an automobile propelled as well as illuminated with acetylene.

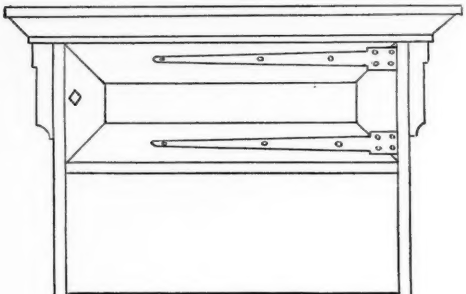
Many theories, which have practically succeeded only in imagination until a year ago, are in actual use today, and acetylene is applied in many and varied ways little thought of two years ago.—"Plumbers' Trade Journal."

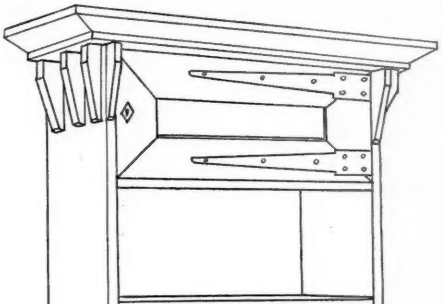
Emery paper and cloth are made by dusting finely ground emery upon paper or cloth coated with thin glue.

A MAGAZINE CABINET.

JOHN F. ADAMS.

About every one, in these days of magazines, regularly receives several magazines, some of which are kept on file, and to which reference is made at frequent intervals. To such readers a stand like the one described will prove of great convenience, the addition of the two cupboards providing room for magazines of less attractive appearance. The design also





makes it suitable for both books and magazines, and would be a nice addition to a boy's room, or for a student's room it would contain both books and papers required in study. The stock used throughout is $\frac{3}{4}$ or $\frac{7}{8}$ in. thick, except the panels, which are $\frac{1}{4}$ in. thick.

The two side pieces are 56 in. long and 19 in. wide. The pieces underneath the lower cupboard and above the upper one are 31 in. long and 13 in. wide. A moulding can be added around the top, as shown in the illustration, or it may be omitted, but as it adds to the appearance, should be put on if the maker has the time for it. A piece of 3 in. moulding 6 ft. 3 in. long will be required, as allowance must be made for the mitred corners.

The front piece at the bottom is 31 in. long and 5 in. wide; the two ends are 13 in. long. The corner joints should be mitred. Ornamental openings are cut out as shown in the illustrations. The board between these pieces and the lower cupboard is nailed through with wire nails, and at the back a piece 3 in. wide is nailed under the flatboard to support the weight of the stand which is nailed to the platform just described.

Four pieces 25 in. long and $8\frac{1}{2}$ in. wide are needed for the shelves, the one above the cupboard being 15 in. above the platform, the next shelf 10 in. above; the re-

maining shelf and the one under the upper cupboard are each 9 in. apart. The front edges of all the shelves are placed flush with the sides, leaving ½ in. at the back for the sheathing. The shelves are nailed in place through the sides. A stronger and more durable way of putting in the shelves, is to cut grooves ½ in. deep in the sides, in which case the shelves should be 25½ in. long.

An additional shelf for the lower cupboard is 25 in. long and 9 in. wide. After putting the frame together and adding the shelves, the back, of matched sheathing, is put on, first attaching with screws strips 1 in. square to the platform board and top board, setting same in ½ in. The sheathing should be 55 in. long and enough pieces are needed to make up the width of 25 in.

The eight ornamental blocks at the bottom are then cut out and nailed and glued in place. They are 7 in. long and 1½ in. wide at the bottom. The eight similar pieces at the top are of the same size, and may be the same in shape. These can be cut out at the mill if patterns are provided with order, and this is recommended to those not having the use of a band saw, as sawing them out by hand means considerable hard work. The spacing is as follows: At the sides the two outside ones are ½ in. from the edge of the sides and the center one midway between these two. Those at the front are added to the sides, glueing them in place as well as nailing.

The upper cupboard is fitted with one, and the lower with two doors. They are all constructed after the same fashion of halved and mitred joints as follows: The rails are cut off to the proper mitre, planed smooth, and the stiles are then marked on the front face to the corresponding mitre. Both rails and stiles are then halved to a good fit, the overlapping parts of the stiles being at the back and not showing at the front. A rabbet is cut all around the inner edges to receive the panel. When finally cut and fitted, the joints are glued up and put between clamps until the glue is dry. The panels are then put in and fastened with small nails or screws. This method of putting in the panels gives a flat surface to the whole back of the door. Another way, if one has a grooving plane, is to cut grooves in the door frame and at the panel in the grooves, using stock for panels somewhat thinner than with the first method.

The dimensions for the doors are as follows: upper door, rails, 25 in. long and 3 in. wide; stiles, 9 in. long and 3 in. wide; panel, 19½ in. long and 3½ in. wide. For the two lower doors, stiles, 15 in. long and 3 in. wide; rails 12½ in. long and 4 in. wide; panel, 7½ in. long and 4 in. wide; panel, 7½ in. long and 7 in. wide. The illustration shows fittings of ornamental hinges, which should be of black iron, if same can be made or purchased, but as such fittings are not to be found on sale in most cities, oxidized brass ones may be substituted, in which case the reader can make them up rom strip brass if not readily purchased. The real hinges are of the ordinary kind, hung in the jamb of the door, the ornaments being separate pieces added after the wood has been fully finished. Nothing has been said about finish, this being the usual dark stain and a wax finish.

ACETYLENE BLOW-PIPE.

An acetylene blowpipe is described in the "Mechancal Engineer," London, due to one Fouche. This tool consists of a flame of acetylene gas blown in the usual way with a blowpipe, but with oxygen gas, so that the resulting temperature is enormous because the flame contains no inert dilutent nitrogen. Such a tool should be of very great service in the workshop, and also in the field. By its aid a broken locomotive frame could be welded. It should be useful at sea for repair work, and in many ways it will prove of service. The apparatus is simple and consists of a supply of the two gases, a suitable water seal, and the blowpipe. A rod of pure iron serves as a soldering-stick or making up supply. It is said that some of the carbon from the flame combines with this pure iron and converts it into mild steel. The superiority of the acetylene-oxygen flame over the oxhydrogen flame lies in the fact that for each cubic metre of oxygen there are theoretically required two cubic metres of hydrogen, but the flame produced is so oxidizing that practically it is necessary to employ a double quantity of hydrogen. Theoretically, two and one-half volumes of oxygen are required for each volume of acetylene, but in practice only 1.7 volumes of oxygen are used. The flame of acetylene is much less diffused, and the heat is therefore better applied, and less is wasted in heating up surrounding metal needlessly. Thus, for the two mixtures, the heat per cubic metre will be: for acetylene 5338, for hydrogen 2473 calories. These and other considerations are said to account for the fact that ten times as much hydrogen as acetylene is required for a given piece of work, or one and a half times as much oxygen.

Sulphite of aluminum is a compound that can successfully be used in making wood fireproof. When strongly heated this compound leaves an infusible and non-conducting residue to cover and protect the cellular structure throughout the wood. It absolutely prevents the propagation not only of flame, but even of a glow because of its non-conducting and unalterable character. Sulphate of aluminum in concentrated solution is far more efficient than an alum solution; in fact, it would seem as if the alkaline sulphate of the alum simply detracted from the power of the aluminum sulphate in the matter of making wood fire resistant.

IMPORTANCE OF TRADE SCHOOLS.

To be educated, in days gone by, meant simply to have one's mind stored with information gleaned from books. To be taught how to make a practical application of knowledge was not considered necessary. Modern thought concerning education is very different from the thought of earlier years. Men have come to realize that to be symmetrically educated one must have mind, body and soul trained and developed.

Among the factors that illustrate the tendency of modern education, the trade school stands out prominently. It endeavors to combine the training of mind with that of hand and so to develop a symmetrically rounded character. At the meeting of the National Education Association held at Asbury Park early in July, Frank A. Vanderlip, vice-president of the National City Bank of New York, gave some excellent thoughts on the importance of trade schools, from which we present the following:

In the group of industrial nations there has come forward in recent years one that has taken a place in the very front rank among industrial competitors. It has reached a pre-eminent position in many special fields of industry, wresting from others the vantage they had long held in serene security. That nation is Germany. By the aid of rapidly developed skill and constantly improved methods, Germany has closed its own markets to the products of the manufactures of other countries. But Germany has done much more than that—it has developed an ability successfully to compete in the neutral markets of the world, until today it shows the greatest capacity in this field of international industrial competition that is displayed by any of the great nations.

In accomplishing this remarkable industrial success Germany has had little aid from nature to make the task an easy one. There has been no wealth of raw materials such as we Americans have had to aid us. There has been no vast homogeneous domestic market such as has been of vital importance in building up our manufactures. Her people have lacked the peculiar inventive ingenuity which in many fields of industry has been the sole basis of our achievements. Her artisans have possessed almost none of the delicate artistic sense which makes French handiwork superior to the obstruction of all tariff walls. Our industries were forced to grapple with English competitors entrenched behind a control and domination of the international markets which for generations have been successfully maintained. But amid this poverty of natural resources, and from among a people not signally gifted either with inventive ability or artistic temperament, there has in a generation emerged an industrial nation which stands forth, if we take into account the disadvantages against which it had to struggle, as a marvel of economic development.

I have had a somewhat unusual opportunity to study the underlying causes of the economic success of Germany, and I am firmly convinced that the explanation of that progress can be encompassed in one single word —the schoolmaster. He is the great cornerstone of Germany's remarkable commercial and industrial success. From the economic point of view the school system of Germany stands unparalleled. The fundamental principle of the German educational system is, in large measure, to train youths to be efficient economic units. In that respect the German system is markedly at variance with the present devolpment of our own educational system. In the German schools the most important aid in the work of successfully training youths into efficient industrial units has come from an auxiliary to the regular school system. It has come from that division of instruction known as the trade schools. The German trade schools have been so designed that they supplement the cultural training of the common school system. They are devised to give instruction which will be practically valuable in every trade—in commercial and industrial calling. They are so arranged that their work supplements both the cultural training of the academic system and the technical routine of the daily task. These schools are the direct auxiliaries of the shops and offices. They have been the most powerful influence in Germany in training to high efficiency the rank and file of the industrial army.

The students in these trade schools, you understand, are youths who have completed the regular compulsory educational course and have gone out into the ranks of active industrial and commercial workers. The hours of instruction are so arranged that they fall outside of the regular hours of labor in shop or office. The curriculum is broadly practical. It includes the science of each particular trade—its mathematics or chemistry, for instance—and its technology. But it does not stop there. Principles of wise business management are taught. The aim is to prepare a student for the practical conduct of a business. He gains knowledge of the production and consumption of markets, and of the causes of price fluctuations. He is put into a position to acquire an insight into concrete business relations and into trade practices and conditions. Are not these aims worthy of our schools? What truer democracy can there be than to have a school system that will point the way to every worker, no matter how humble, by which he may reach a clearer comprehension of the industry in which he is engaged, and with the aid of this knowledge may rise to a position of importance in that industry?

Such an auxiliary system of trade schools will be available for the youth after he has left the direct influence of our present school system. There are in the United States ten million of population between

the ages of fifteen and twenty years. Three-quarters of that number are not in attendance at any school. Here is a group of youths, seven and one-half millions in number, from which the students of such trade schools would be drawn.

The present generation of American youth, entering industrial or commercial life, is to encounter a new and in some respects a harder condition of affairs. The industrial life of this country has in a decade undergone changes more significant than has been encom passed before in a period of two generations. No one whose life has been largely in the classroom is likely to have comprehended fully the true significance of the development of the forces of combination—combination in the field of labor as manifested in the growing power of unionism, combination in the demand of capital as manifested in the trusts, concentration in the control of industries, in the subdivision of labor and the aggregate of wealth. The display of the forces of combination, equally significant in the fields of labor and of capital, has brought changed conditions in the problem of human industrial endeavor. The welfare of the people and the position which our country is to maintain among nations, both depend on no single thing more than on the recognition of these changed conditions by our educators. You must provide the educational requisites which these changed conditions make imperative.

The forces of combination—the labor unions and the trusts—are united and working in harmony to accomplish at least one thing. They are united in a tendency to make of a great percentage of our population commercial or industrial automatons. They both tend to sub-divide labor, and thereby limit the opportunity to acquire a comprehension of broad principles. They both tend to circumscribe the field of the apprentice, narrowing his opportunities, forcing him into petty specialization and restricting his free and intelligent development. All this is placing us in grave danger of evolving an industrial race of automatic workers, without diversity of skill, without an understanding of principles, and without a breadth of capacity. There is but one power that can counteract that tendency—that power is the schoolmaster.

These youths, who can gain from their daily work only that narrow routine technical experience which in the main is all that the conditions of modern industry offer, have a right to demand something more. They have a right to demand the opportunity for a practical education. As modern conditions narrow their technical training, those same conditions broaden the opportunity for the man who does acquire knowledge which will give him a grasp of more than a single detail of his business. I believe it is your duty to provide schools which will supplement the routine of the day's work, schools which will give to these youths a comprehension of the relation of the narrow daily task to the broad industry, schools that will sup plement such cultural training as our present system has provided with practical knowledge of immediate and valuable application, schools that will counteract the discouragement and monotony of the daily round of toil and create in their stead some enthusiasm for work, build up a love of labor by showing an intellectual side to what was before blank mechanical routine.

OIL IN BOILERS CAUSE OF FAILURE.

That many of the so-called mysterious collapses of furnaces in apparently clean boilers is due to the presence of oil is the contention of an English engineer. He maintains that if the surface of the furnace in a boiler for 200 pounds pressure is kept clean, the temperature of the metal will never reach the point at which the original tensile strength will be appreciably reduced, even under high rates of evaporation. If, however, the surface is simply rubbed over with an extremely thin coating of mineral oil, the temperature immediately rises to over 650° with a moderate evaporation. It, therefore, follows that if a mere coating of oil of inappreciable thickness raises the temperature of the metal beyond the limit of safety, an extremely thin scale or deposit containing a high percentage of oil will inevitably result in dangerous overheating. He accounts for the fact that practically no oil is ever present in the harmless looking deposit found on the crown of collapsed furnaces by the theory that the temperature of the plate has been so high as to drive off the oil by distillation, and maintains that if the deposit were scraped from other parts of the boiler it would never fail on analysis to afford a solution of such accidents as are termed mysterious by those who do not realize the dangerous effect of a slight coating of oil.—"Chicago Tribune."

There is much that is somewhat mysterious about the explosion of nitro powders, gun cotton and other high-grade explosives, but it is agreed by all careful observers that when nitro powder is surrounded by a medium such as air, water or rock, the explosive force is exerted equally in all directions, but manifests itself chiefly in the direction of the least resistance. That is, if a blast is formed in a drill hole the gases formed by the explosion in their efforts to escape, will tear away a portion of the rock surrounding the drill hole. When dynamite is placed on top of a rock it will shatter the rock if it be not too large. If the same amount of powder is placed under the rock and in contact with it, it will also shatter the rock, showing that the explosive force is exerted in an upward as well as in a downward direction. The impression that many have that the explosive force of nitro-glycerine and dynamite is downward only, is erroneous.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

VI. Continued Testing of Lenses.

A few additional directions for testing will probably be of service to the reader.

My mirror was supported on a large board, the lower edge of the mirror resting on a ledge screwed to the board and deep enough to carry the screens as well. Both mirror and testing apparatus should be kept as firm as possible--a heavy tripod about 3 ft. high is convenient for the latter, and the observer can work sitting; while a stout easel forms an efficient support for the mirror. The mirror can also be suspended by a strap from a nail, and rest against the wall; but that plan does not give so much power of adjustment. The mirror may, with advantage, be at a somewhat lower level than the testing apparatus, so that the tube of the latter (which, of course, points to the center of the mirror) is inclined downwards.

While the best place in which to carry on testing is undoubtedly a long cellar or underground passage with a stone floor, excellent results can be got almost anywhere, provided sufficient care is taken: (1) That the temperature of the air is uniform as possible; this, of course, means no fire, and (2) that the floor is as free as possible from tremors. Dr. Common did the testing of his 5 ft. entirely out of doors and found the conditions excellent; and, in my own case, as I had no cellar or stone floor at my disposal, the testing had to be carried out on an upper floor of a "timber-framed" house. By using a combined screen, and keeping perfectly still, and making every one else do so, I succeeded in getting very concordant readings. The least movement of anyone else in the house made the image dance about in a surprising manner.

Having placed the mirror on some firm support, we arrange the testing apparatus so that the distance of the pinhole from the surface of the mirror is approximately equal to the radius of curvature— *i. e.*, twice the focal length—and so that the tube is pointed as accurately as possible to the center of the mirror. The pinhole is removed and the lamp lighted, and all light from the lamp is screened off as far as possible, except that issuing from the ½-in. hole and falling on the mirror, the room being darkened, of course. The lamp ought to be so adjusted in height that the brightest part of the flame is level with the pinhole, or the center of the larger hole, and draughts must be carefully avoided, or the illumination of the mirror will flicker in a disagreeable way.

The mirror is adjusted until the reflection of the flame is thrown back to the tube—this will take some time at first, as the image will be faint; but the difficulty is soon overcome by the use of a large sheet of paper and patience. A cap or disc of white card to fit the end of the tube will prove useful, as the image can be thrown on this, and when the paper cap is removed the light will pass through the tube as required.

The brass plate with the pinhole is now placed in position, and the observer looks through the tube at the mirror. If the head is moved back a few inches the image of the pinhole should be seen through the tube—and the testing apparatus may be moved about until the image of the pinhole is accurately centered.

We may now make a preliminary examination of the image of the pinhole with an eyepiece or, if the eyepieces are not yet procured, with a simple pocket lens. The apparatus must be moved to or from the mirror until the image can be brought into good focus, when, if the curve is fairly regular, the image should be sharp and well-defined. If the grinding and polishing have been carried out as recommended in my previous letter, the figure will probably belong to class A, the

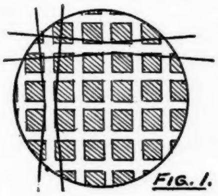


FIG. 1.

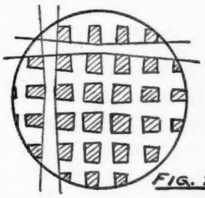


FIG. 2.

oblate spheriod; but if the stroke in polishing is too long, or the pitch too soft, it may tend to B or C. Whatever the appearance inside and outside the focus may be, one thing is essential: the image, both in focus and out of focus, must be absolutely circular and symmetrical. To judge of this the lens must be held accurately at right angles to the axis of the tube or distortion will be introduced, and it is better in every way to use a low power eyepiece which can be screwed into the tube. If one is not at hand a lens may be mounted in a paper cap to fit the tube.

If the image is not quite circular, the surface of the mirror is not a perfect "surface of revolution," and there is nothing for it but regrinding or starting afresh. Unless the curve is the same, whichever way it is taken across the mirror, good definition is quite impossible.

It is well, however, not to be in a hurry to condemn the mirror at the first glance. While I was working at the refiguring of my first 9 in., I used for a short time, to support the mirror, the back of a marble washstand —the mirror was therefore resting against marble which reached about 6 in. up its back. I was dismayed

to find on testing, immediately after polishing, that the image was hopelessly distorted and unsymmetrical. This, however, disappeared in half an hour or so, and the testing was quite satisfactory. The cause of the temporary distortion of the mirror was apparently that the mirror having been polished in a warm room had not had time to take the temperature of the much colder room where the testing was being done, and when the mirror began to cool down, the temperature of part of it in contact with the marble would naturally fall more naturally from being in contact with the upper part.

After examining the mirror roughly with the eyepiece—and it may be mentioned that the eyepiece test is not absolutely to be relied on, as many eyepieces have a certain amount of spherical aberration of their own which tends to make the mirror appear nearer to class A than class C—we may proceed to the screen test. Remove the lenses of the eyepiece and screw its mount into the tube. Then, with the eye a few inches behind the end of the tube, move the head from side to side and note whether the image and diaphragm in the eyepiece move relatively to one another. If they do, move the testing apparatus to or from the mirror until there is no relative motion, and then move it to the left so that the image is just not extinguished by the right-hand edge of the diaphragm. If now the eye is brought close up to the tube and the mirror viewed, it will be seen as it were flooded with light. Depress the left side of the baseboard by a gentle pressure of the hand, and the screen (the right edge of the diaphragm) will be seen to cut off the light from the mirror, the appearance being that described in Chapter IV. Care should be taken, of course, to have the screen exactly at the focus.

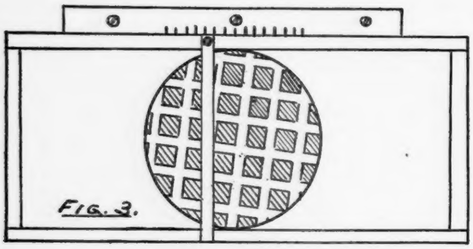


FIG. 3.

The figuring or alteration of the curve from A to B and then through C^1 to C^2 is to be managed. It is evident that we want to flatten the edge of the mirror so as to increase the focus of that part, or to increase the curvature of the center and so to decrease the focus thereof. The latter is the method I adopted, acting on the advice of the same kind expert who enabled me to perfect my first mirror.

It will be seen that if the polisher has its square the same size all over, the curve will, at any rate if the pitch is fairly hard and the stroke not excessive, tend to retain its " A " figure, or even, as I found, to show increase of the curvature at the edge as compared with the center, so as to make the A figure more pronounced—*i. e.*, the facets decrease in size uniformly from center to edge, and in consequence the work done by the rouge in abrading the glass in the center of the mirror is more than at the edge, with the result that the curvature in the center tends to increase relatively to that at the edge; or the mirror, in other words, passes from A to B and to C in succession.

Fig. 1 shows the polisher which up to to the present has been used. If now a series of inclined lines are drawn parallel to one another, as in the figure, starting from the edges of the central facet, and the pitch is cut away or trimmed off along those lines, we get a polisher like Fig. 2, which will produce the effect desired. The line along which the pitch is cut must be kept parallel, and a simple way of doing this is to use the instrument shown in Fig. 3. This simply consists of a frame of wood just wide enough to contain the polisher and rather more than twice the length, and deep enough to hold the crosspiece shown, clear of the surface of the polisher. By turning the polisher round on its center the crosspiece can be made to guide the chisel or trimming tool along the line of any inclination.

The amount of graduation should not be very great at first—as when once the figuring is commenced the alteration of figure is somewhat rapid—and it is of the utmost importance to spare no pains in constantly testing the curve as previously described. So long as no attempt is made to figure the mirror, and the facets are consequently of uniform size, the testing may be performed every hour or so; but when once the polisher is graduated, and the focus of the center begins to shorten, testing should be carried out after every twenty minutes' work, or even oftener; towards the end, five minutes' polishing may make all the difference between success and failure.

I ought to mention another method of measuring the focus of the different zones, as it was employed by Dr. Common for his great 5 ft. mirror of 28 ft. focus. He used, I think, 14 zones of different diameters, and each about an inch in breadth, and placed his testing apparatus in a sort of sentry-box 66 ft. away. Instead of using the screen, as above described, he measured the focus directly by focussing the image by means of an eyepiece. Of course the apparatus above described could be used in this way; but after trying the method I abandoned it on account of the great uncertainty about the focus of the central zone. The eye, mine at least, has such great power of accommodation for focus that the tube may be moved a good deal without affecting the sharpness of the image—this is also due to the very sharp angle at which the central rays converge—also many eyepieces have considerable spherical aberration, which is different, of course, for central and marginal zones, and which confuse the readings and adds a fresh source of error comparable with the aberration we wish to measure.

For this reason, when testing finally int he telescope, it is most necessary to use the eyepiece with which most work is to be done. A power of about 300 for a 9 in. mirror, and the eyepiece should be the very best that can be got.

If a low-power e. p. is used in testing in the telescope, the mirror, even if perfect, may show considerable under correction (class C or even B—*i. e.*, elliptic or even spherical), which may quite disappear with the ordinary working power. This matters little in practical telescopic work, as low powers are not usually employed on objects requiring critical definition. My first 9 in. mirror shows signs of under correction with an ordinary Huyghenian of 60 diameters; but an e. p. from my Voightlander prism binoculars, giving a power of 80, shows no signs of error whatever.

It will be seen that I attach considerable importance to the final testing in the telescope. This, I suppose, can be omitted by experts who have had great practice in testing; but I think it is best to have a tube and rough mounting ready as soon as the focal length of mirror is accurately known.

While testing on a star in the telescope it is very important to remember the distinction between the case of incident parallel rays (from a star) and of divergent rays (from a pinhole at the center of curvature). If the reader will look back to Chapter V, he will see that the appearance desired is that of Class B under the pinhole test.

There is no need whatever to silver the mirror when testing in the telescope; the flat should be silvered, but as a 9 in. unsilvered mirror gives enough light to show the companions to Polaris and Rigel, there is ample light from a 1st or 2nd mag. star.

RUSH CHAIR SEATING.

ARTHUR MAETKZER.

The use of rushes for the seating of chairs, settees, etc., is gradually gaining favor in the public taste, and although a large number of people are erroneously of opinion that this class of work is a modern idea, it is, in reality, an old style revived.

Morning-room suites and bedroom chairs are, perhaps, the most favored kinds of furniture upon which rushes are used, although occasional chairs are often found nowadays with this class of seat. The form or pattern of rushing appears to be made up of four sections, each of which, in the case of a square seat, appears to come to a point in the center, and in a rectangular shape, presents a pointed appearance in the two side sections, and a flat edge in the case of the front and back sections, although in reality the whole of the work is one piece, the divisional lines being formed in the process of weaving. The material used is of various kinds, the most common being ordinary rushes, which are greenish brown in color, and are very strong. In the more high class work fancy grasses are often used, these being covered with a fine strand of color, which gives the work the appearance of having been seated with a fancy cord.

Success depends entirely upon the evenness and shape worked up, as the actual weaving is extremely simple. The legs of chairs to be rushed project from ¼ to ½ in. from the level of the seat rails, and it is usual, although not absolutely necessary, to run a bead of polished ⅛-in. wood from leg to leg on the outside edge of the chair frame, such bead being run over the rush. This course, besides forming a pleasing finish to the outside edge of the seat, precludes the possibility of the rush shifting by constant use. Where the common rushes are used they should be steeped in water before being used as, being brittle, when dry they will not stand the amount of handling necessary unless so treated.

In Fig. 1 we have a diagram of a square seat frame, showing the method of weaving the rushes; and although, for purposes of illustration, the strands are represented as being loose, they are, of course, in actual practice kept close to the framework. Before entering into the details of the weaving, it will be well to mention that whenever the rushes run on the top of

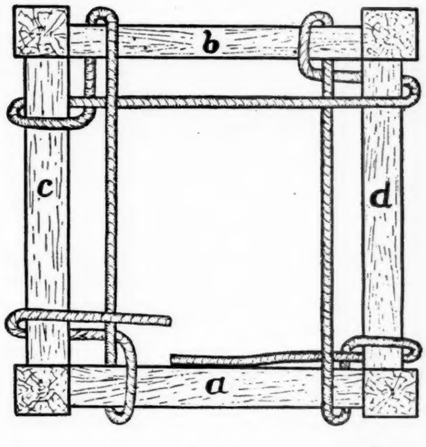


FIG. 1.

the seat they have to be twisted into the form of rope, such twisting being done as the rush is brought to the surface. Although at first this operation may prove somewhat difficult to accomplish, as the worker gains dexterity with his fingers he will find it quite easy.

Where the chair frame has to be repaired or polished, this should be carried out before the rushing is done, but in polished work the final spiriting can be left with advantage until the seat is filled in.

The chair and rushes being ready, a start can now be made in the direction of the weaving, and during the working of the initial stages it will be well to make a careful study of Fig. 1. On the inside of rail *A* fix, by means of short clouts, the free end of a piece of rush; carry same under *D*, close to the leg, and bring up on the top of this rail; at this point the twisting has to be done, but as this process has already been mentioned further reference will not be necessary. Now run the material under rail *A*, bring out on top, and take it right across to the underneath of rail *B*, coming over the rail and thence to under *D*. The rush now comes over *D*, and right across to *C*, where the under-and-over process should be repeated, and the stuff taken round the left-hand side of *B*. From here we run to *A*, and back to *C* again, another long run being taken

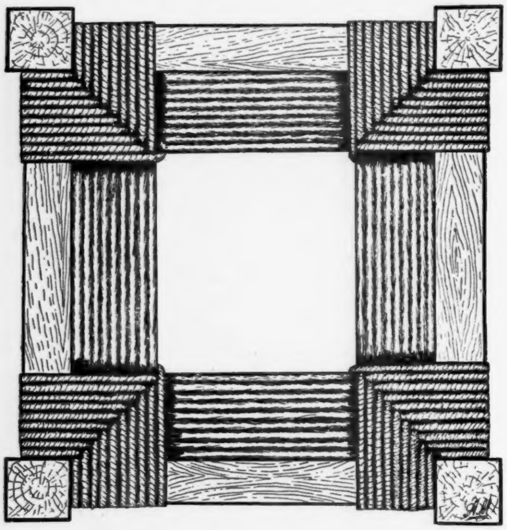


FIG. 2.

to *D*; and the same process is continued from rail to rail until the whole of the seat is filled in. As the seat is covered the long strands are hidden from view, although, of course, part of them form a certain portion of the top surface. In Fig. 2 we give a copy of Fig. 1 with a quantity of rushing done.

In practice it will be found that chair seats are often more or less rectangular in shape, and that when the sides are filled in there is an open gap in the center of the seat, running from back to front which cannot be filled in according to foregoing instructions. At this point, which for convenience, we will presume is where the rush has come over *D* and is returned to the underneath of *A*, Fig. 1, a different form of weaving has to be brought into requisition. Ascertain the center of the long strands, and pass the rush over the rail *A* and right through the center of the seat; run it underneath to rail *B*, bring up to the top, continue to the center and take through to the underneath. Run it over *A* and thence through to the bottom, coming over the back and up to the surface again, continuing this process until the whole of the remaining open portion of the seat is filled in, see Fig.

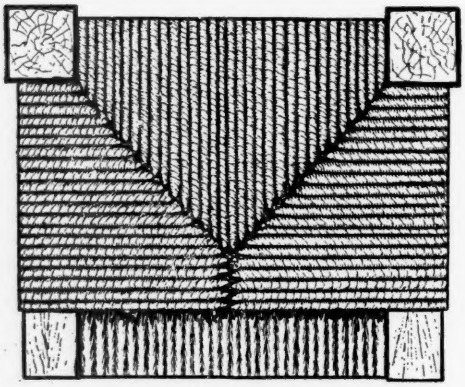


FIG. 3.

2. It will be seen that we have now got the rushes from center of seat to back, and also from center to front. Were the seat composed of rush only, it would not be possible to work up any sort of shape in the sections; and in order to get over this difficulty, a small quantity of flock or, what is better, the "rugging" used by upholsterers, is packed between the layers of rush from time to time as the seat is filled in. In packing the seat up, care should be taken to obtain a good

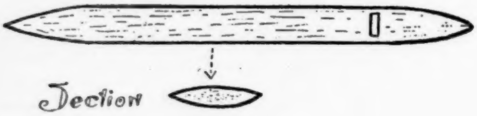


FIG. 4.

"sweep," the highest point being in the center of the sections. Where joints have to be made in the material, they can be made either by tying the ends of the rush together, or by tucking between tightened strands; but if the latter course is adopted care should be taken to ensure their being securely fastened.

Where shaped seats are to be rushed, it will generally be found that they work up without any particular difficulty, and should the back get filled up before the front, work the rush a bit tighter on the back rail. The seats of armchairs and settees, although larger in size than those of standard chairs, are worked up in the same manner, although rather more "swell" can be allowed when inserting the stuffing material.

A very pretty and effective material for rushing is that known as Canary cane, which is imported into

this country from Madeira. It is of the fashionable biscuit or yellowish ecru color, and looks remarkably effective in combination with a dark mahogany or ebonized framework. In working this cane, great care should be taken to see that it is made thoroughly pliable by soaking before it is used. Do not use the cane too thick, and see that the surface is not dirtied or damaged in working up. Fine manilla rope is another material which is utilized for rushing seats, and although, correctly speaking, this is not rushing, it forms a very good seat, but has to be thoroughly well packed between the surfaces with rugging, as there is not nearly so much resistance in this material. Where long lengths of stuff are used, it will be found much more convenient to wind it round a stick so as to do away with the pulling of the whole length through every time a turn is made.

There is another pattern of rushing which, although not very largely favored, is sometimes used, the surface of which, being made up of crossed strands of material, presents a chequered appearance. The seat having been freed of the old rush, run a series of fairly loose strands from side to side of the chair seat, taking them first over the top, and then underneath until the whole of the seat is filled in one way. In putting on these first strands it will be necessary to fix them at each end on the outside edge of the seat rails, otherwise they will get mixed up and be difficult to work. Keep the underneath rushes fairly tight, as it will not be necessary to lace these as much as those on top.

The next step is to put in another series of strands running from back to front of seat, and to do this we shall require the services of a wooden needle, which can be made from a piece of boxwood about 7 x ½ x ⅛ in. thick. Fig. 4 shows shape of needle. The second lot of rush will have to be laced as it is put in. Start from the front and, with the aid of the needle, thread the material over four of the loose strands, under the next four, and so on, until the back is reached. Now pull tight and work up to the side framing, and thread the rush through one or two of the under strands when bringing it back to the front from the underneath of seat. Four rows in all of rushing should be run in, and then another four running opposite to the last set; that is to say, where the rushes ran under strands, put them over and *vice versa*. Every time four strands are put in alter the lacing and so continue until the whole of the seat is filled in. Care should be taken in putting in the side-to-side strands that they are left loose enough to admit of lacing, as this process takes up a goodly quantity of rush, and if it is too tight it will break before the seat is finished, owing to over pulling.—"The Woodworker," London.

Two nozzles are used on a water wheel of small diameter where high speed is required. The power of the wheel is thus doubled, though twice the amount of water is required.

HOW TO PAINT A BATH TUB.

Assuming that it is an old metal tub which has never been painted.

First—the tub should be thoroughly cleaned. To do this, wash it with soap and water, or with soda, or with sapolio, in order to get off the grease; then rinse out with clean, hot water wiping dry with dry cloths.

Then roughen up the surface of the tub by going over it with fairly coarse sandpaper, and wipe out the little dust and dirt produced by the sandpaper with a dry cloth.

The tub is now ready to be painted. The first coat should be white lead in oil thinned with turpentine, using a flat bristle brush in putting it on and being careful not to get on too thick a coat. Allow this coat to dry for at least twenty-four hours, when a second coat of this same lead should be applied in the same way and allowed to dry also for at least twenty-four hours.

The tub is now ready for the coat of enamel, using a kind especially made for such purposes. Open the can and stir the enamel thoroughly and apply with a flat bristle brush, carefully and evenly. One coat of this enamel is sufficient, which should now be allowed to dry from four to six days.

When you again commence using the tub do not allow *hot* water to run into it first, as it may soften up the enamel. If the tub has been painted in the past, the old paint should be scraped and sandpapered off before painting.

REMOVING OLD PAINT.

In answer to the question of a reader of its columns as to what will remove old paint and hard oil from any surface, a recent issue of the "Painter's Magazine" contains the following, which may be of interest to some of our own readers: When the surface is to be repainted, in which case a slight raising of the grain of the wood is no objection, the simplest method of preparing the remover is as follows: Dissolve 4 pounds caustic soda 98 per cent, or as many pounds concentrated lye in 1 gallon boiling water and allow to cool. In another vessel mix ½ pound each of starch and china clay in 1 gallon of hot water. Beat this well so as to have no lumps, and when cooled off some add it to the soda or lye solution, stirring well in the meantime, when it forms a thick, smooth paste. Apply this paste with a fiber, not bristle, brush to the surface in a heavy film, and when the paint or varnish is raised wash with warm water. To remove any traces of causticity, give the surface a coat of vinegar and allow to dry before repainting. For removing varnish from wood that is to be refinished in the natural, a mixture of 3½ pints American fusel oil and ½ pint turpentine will lift the varnish without raising the grain or discoloring the wood.

A TABLE LAMP.

JOHN F. ADAMS.

Table lamps, other than those of a very plain character, are relatively expensive when purchased. A very attractive lamp can be made, however, as herein described, at a most moderate cost for materials. The illustration shows the general design; the particular feature, which serves to keep down the cost, while at the same time giving a lamp that will provide abundant light, is the use of an ordinary central-draft, metal lamp, which can be purchased of about any lamp dealer for a dollar or less. Secure one with black iron finish, if possible, as it is more in keeping with the design than a brightly polished metal.

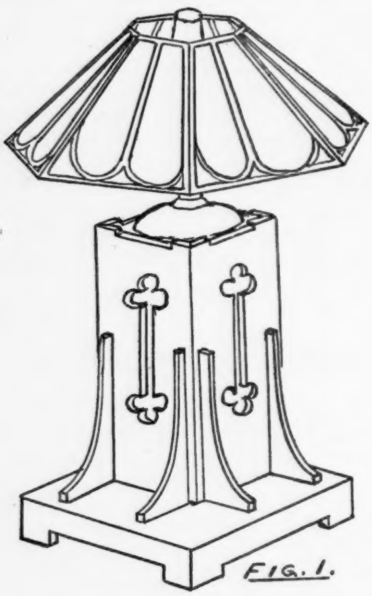


FIG. 1.

As a lamp of this type should preferably stand upon a table of the mission style, the wood and finish of lamp should be similar to table. Where no special kind of finish is required, if made of red gumwood and finished with a dark brown or red filler as preferred, a good effect is obtained. A new and popular combination is the use of birdseye maple, filled and stained to a medium steel-gray, and wax finished. Other woods and finishes will readily suggest themselves for use in particular places.

The pillar is made of four pieces 7 in. wide, 15 in. long and ½ in. thick. The edges of these pieces are beveled to 40° with glue and wire nailed with finish nails. If these joints are well fitted they will be hardly discernable. The eight angle pieces are 10 in. long, 1½ in. wide at the bottom and ½ in. at the top; the front edges being cut to the curve as shown in Fig. 2. The outer edges of these pieces are ½ in. from the corners of the pillar.

The ornamental slots in the sides of the pillar are made by boring three holes at each end and then cutting out with a compass saw, finishing with a chisel and file. The centers of the holes at each end are 8 in. apart; the lower one 4 in. from the top of the platform. The tops of sides of the pillar are also cut out as shown in Fig. 2, the slots being ½ in. deep and 4 in. long. If ½ in. holes are bored at the inner corners of these slots, a good curve is thus obtained; use a sharp bit, however, so that the cut will be a smooth one.

The platform is made of four pieces 12 in. long, 2 in. wide and ½ in. thick. The ends are beveled to 45° and also the upper inner edges so that the top, which is also beveled, will let down into the sides, making all joints inconspicuous. The top is 12 in. square and ½ in. thick, the outer edge beveled to 45° and a hole 5 in. square cut in the center. The openings at the bottom of the side pieces are 7 in. long and 1 in. high, and are to admit the air to the lamp. These openings or those in the sides of the pillar can be omitted but not both of them. When complete, this platform is nailed and glued to the pillar and angle pieces.

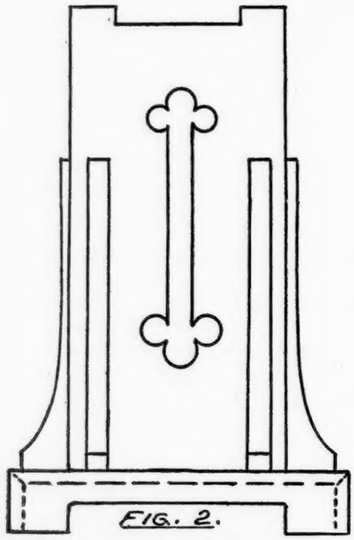


FIG. 2.

The top of the pillar is fitted with a square board in which has been cut a circular hole, of a size to just fit

under the shoulder formed by the joint at the center of the oil well of the lamp. Careful measurements should be made of the lamp to be used and the hole cut accordingly, to lines accurately marked with dividers.

After cutting out the opening with a fret or compass saw, fasten in the top of the pillar, from ½ to 1 in. below the bottom line of the slots, according to the shape of lamp used, the object being to conceal as much of the lamp as possible, without having it so low that the burner is shaded by the corners of the pillar.

PAPER FROM CORNSTALKS.

Paper can be made from cornstalks at one-third the cost of making it from wood fiber and rags, is the latest advancement in paper making, says "World's Events." A company has been organized to utilize the waste products of the corn fields, and soon the new writing, wrapping and printing material will be on the market. Samples of the new paper show it to be equal to the fine goods made from linen. One sample resembles Japanese vellum so closely that only an expert can detect the difference. In quality it is just as good.

In producing this fine paper, common ordinary corn stalks, of which 53,000,000 tons rot yearly in the corn fields of the Western States, were used. The cost of manufacturing a ton of this paper ranges from $22 to $25. The manufacturing cost of a ton of rags or pulp runs from $60 to $75. Prof. W. R. Patterson, of the Department of Economics and Statistics of the State University of Iowa, recently made an analysis of the new paper and pronounces it equal to the paper made from rag or wood pulp.

The operation is simple. An improved threshing-machine, used on the farm, separates the stalks from the leaves, husks the ears and delivers the stalks bound in bundles ready for shipment. When received at the paper mill the stalks are depithed. The pith is then rolled into a fine paper. The hard outer covering is macerated and digested and used to make coarse wrapping paper and box board. The company owning the patent on the machinery is negotiating for a large paper mill at Kankakee, Ill., where the tests have been made, and intend to go into the paper-making business on a large scale. The company will utilize every vestige of the corn stalk, as certain portions are used in the manufacture of cellulose, gun-cotton, powder, varnish, lubricants, papier-mache, etc. In fact, every shred of the stalk is put to some use in this mill.

TRANSMISSION OF POWER.

The problem of transmitting 100 h. p. a given distance requires consideration based upon stated conditions, viz., drop in the line, power wasted in the line, pressure, cost of copper employed, relation between cost of copper and power wasted in transmission and attendant data. To transmit 100 h. p. 1 mile with 10 per cent drop, if the engine or turbine shows 100 i. h. p., then the dynamo transforms 95 per cent into electrical energy. When 95 per cent enters the line 90 per cent is delivered at the other end. The power delivered at the distant end of the line is 95 h. p., minus 9.5 h. p., 85.5 h. p. The process is not complete as yet, although the power is now at hand, ready for use. It is necessary to transform it again into mechanical energy. This transformation involves a loss of from 5 to 10 per cent, the balance left being the difference between 85.5—8.55=76.95 at 10 per cent loss in the motor, or the difference between 85.5—4.275=81.225 per cent at 5 per cent loss in the motor. The efficiency of transmission in any case, with 100 h. p. at one end and the loss throughout in dynamo, line and motor of 10 per cent apiece, respectively, will be about 77 per cent. The 100 h. p. is thus reduced to 78 h. p. from the beginning to the end of the system. The actual transmission can be readily accomplished if the cost is not prohibitive, but in instances where this threatens to be the case certain means must be employed to raise the efficiency and reduce the cost of installation.

ELECTRICAL STEEL PROCESS.

Manufacturing steel by a new method has been successfully experimented upon in Melbourne, Australia. New Zealand magnetic iron sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its operation. The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine partitions are subjected to the action of reducing gases, which bring the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel, or the malleable iron, as the case may be, is tapped from this whenever that operation is necessary. An interesting feature is the use of fuel oil for heating purposes, employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gases used in existing smelting practice. The work demonstrates that the oil is not only a cheap fuel but is also so thoroughly under control as to insure the best service.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

NOVEMBER, 1905.

We are frequently in receipt of letters from subscribers who, having purchased one or more of the early volumes bound in cloth, desire to exchange the separate copies of subsequent years for bound volumes, and asking what extra charge would be made for such exchange. It is not possible for us to make any arrangement for doing this, upon terms which would be as favorable, mailing expenses included, as the offer we do make; *i. e.*, to send binding covers to those ordering same at substantially cost price, 25 cents.

The binding of our yearly volumes is done by a wholesale binding firm, and in large numbers so that we may obtain them at a cost which enables us to make the low price at which we offer them. This firm does no retail business, and would not bind single volumes at irregular intervals. As a bindery is to be found in about every large town and city, at which binding of this kind can be done at about the same charge that would be made to us, the purchase of the binding covers enables the owner to obtain the binding at about the same expense that would be incurred in mailing the magazines to us, having them bound, and the return postage. The bound volumes thus obtained are uniform in binding, and no risk incurred of loss or damage in transit. We think that this arrangement will be quite acceptable when fully understood, as it is decidedly the most convenient one, and in the majority of cases less in cost than an exchange could be made for.

It is necessary to request that orders for binding covers be sent as soon after the completion of each volume as possible, that the covers may be made at the same time as are those for our regular supply, otherwise the filling of an order may be delayed until another lot of magazines is being bound. If you want the covers, therefore, for volume IV., which was completed with the October number, send your order at an early date.

The number of letters received from readers who are desirous of forming a society devoted to model engineering and kindred subjects, has been large, and the interest shown in the subject has been very encouraging. Many helpful suggestions have been offered, and we are now engaged in formulating a definite plan of organization, the details of which will be announced as soon as possible. The value of such a society seems to be quite generally recognized as providing the means for bringing together those who are interested in such work, and it believed that the mutual help to be received by members would be of the greatest benefit. It was this belief that influenced us to propose the society, and we are much gratified to learn that so many are of the same opinion. Those who have been considering the matter but who have not yet written are invited to do so, that local bodies may be planned whenever a sufficient number have expressed their interest.

The revised premium list not being fully completed has led us to put separate pages in such of the recent numbers as afforded space for same. In this way subscribers can select desirable premiums before receiving the complete list.

FLASH SIGNS; HOW TO MAKE THEM.

T. B. MEYER.

The following, with accompanying diagrams, gives full directions for making an electric flash sign, such as is used extensively at the present time in the larger cities, principally for advertising purposes.

Heretofore electric flash signs have been confined to the more expensive apparatus, such as are seen on the theatres and buildings requiring an expensive flasher and motor to operate the same. The sign here described is used more particularly for window displays though the principle involved may be applied as well to larger signs.

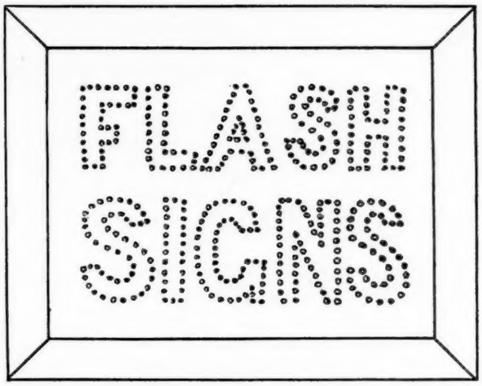


FIG. 1.

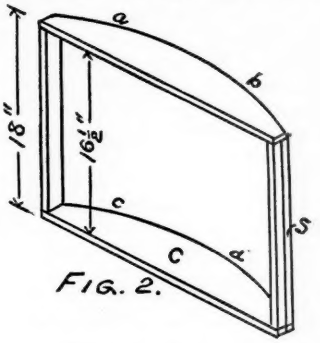


FIG. 2.

FIG. 3.

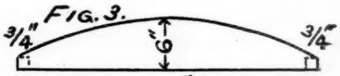
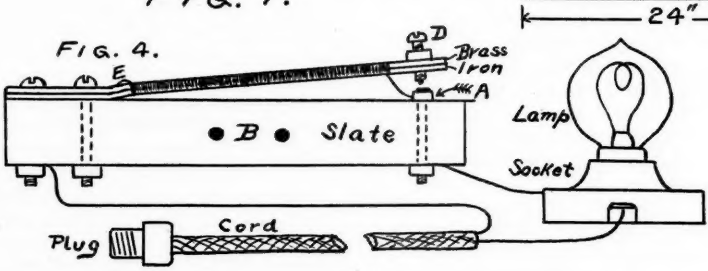


FIG. 4.



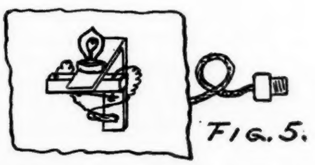
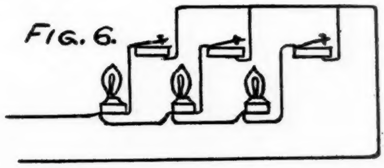


FIG. 5.

FIG. 6.



We will confine our attention to one consisting of an ordinary 1½ in. picture frame moulding, taking an 18 x 24 in. glass or sign. This, allowing for the usual ¼ in. rabbet in picture frame moulding, would make our sign over all 20½ x 26½ in. Such frames may be procured at any picture frame store, to order, for from 30 to 60 cents, depending, of course, on the wood selected and finish of the moulding. A frame may also be made of moulding used for interior finish or dados.

There are two methods by which we may complete the front of our sign: By employing an 18x24 heavy cardboard with the desired lettering painted thereon; white board with black letters will answer, though white letters on black background are to be preferred, or by having the wording painted on glass in stippled white in order to insure transparency, and filled in all around with black. The latter will cost more but makes by far the better appearing sign.

If cardboard is used, a plain glass front must also be used to prevent the cardboard from buckling. The lettering is punched in outline as shown in Fig. 1; the holes being spaced about ¼ in. apart; on the back of cardboard are then pasted various colors of tissue

paper, which give a varied color effect from the single plain lamp placed behind.

As a support for this lamp, as well as a reflector and means of keeping out other light, we next build a semi-circular box, as shown at Fig. 2. This consists of two pieces of ¾ in. soft wood, 24 in. long by ¾ in. at the ends and 6 in. at the center. Fig. 3. These are fastened together by two strips of wood ¾ in square 16½ in. long, with ordinary finishing nails. Next, as a backing for the box, fasten a sheet of 20 x 28 tin with carpet tacks to the framework just completed, tacking down well over the curve *ab* and *cd*, Fig. 2, and the sides of the strips *s* at the end of the frame-work. Paint the outside black with thin asphaltum or black paint, and we then have a light-tight box, which may be fitted in to the frame with hinges at bottom to swing open, and a catch hook and screw eye at the top, taking care to allow for the thickness of cardboard and glass.

Our next step is to make an electric thermostat by soldering or riveting together a strip of brass and of soft iron, 1-16 in. thick, ½ in. wide and 4½ in. long. Drill two holes ½ in. apart, at one end, large enough to clear a 6-32 machine screw, and a third at the other end, tapped for a 6-32 machine screw. This is our contact making screw, and should be brass with a 1-8 in. piece of No. 16 or No. 18 platinum or hard silver wire soldered to the end of it. Bend the two-metal pieces slightly at a point 1 in. from the two-hole end.

Then cover between holes with five thicknesses of paraffined paper, shellac down to hold in place, and wind with about 33 ft. of No. 36 single silk covered German silver wire, first soldering end directly to thermostat at *E*, Fig. 4. The winding should be 3 in. in length and clear the holes in the two-metal strip by ¼ in. at either end. Care must be taken that the wire rests only on the waxed paper.

Next fasten this thermostat to an insulating base of slate 4½ in. long by ¾ in. square, with two 1 6-32 in. round head machine screws, with nuts to match on the under side and place a contact screw with 1-8 in. square of platinum or hard silver soldered on its head in the other end of base, so as to come directly under the contact screw in the thermostat. See Fig. 4. The lower contact screw should also be provided with nuts underneath, and the upper one in thermostat with check nut for adjustment.

Connect, as shown in Fig. 4, the brass strip of thermostat on top, and with right hand end wire under screw head at *A*. The insulating base *B*, Fig. 4, may now be fastened by screws and nuts to the bottom of the box at *C*, Fig. 2, or by two 6-32 machine screws through holes at *B* to a metal angle carrying the lamp and fastened by screws and nuts to the tin back of box. This angle is drilled and tapped 6-32 to take ordinary keyless receptacles and lamp, the latter being placed so as to come near center of back of box. See Fig. 5.

Connections are made as shown in Fig. 4, the cord of from 6 to 10 feet being fitted with the ordinary plug and coming through an insulating porcelain or glass bushing in the tin to the lamp and thermostat. Thermostat should be placed with *B* side down in order to bring the adjusting screw *D* to the front, and if put on the wood bottom of the box should have a piece of thick asbestos cloth under it. The cord *E* should be what is called window cord in preference to the ordinary lamp cord, and may be had for about four cents per foot.

The apparatus being ready, see that the point of adjusting screw *D* comes within 1-16 in. of contact *A*, before turning on the current. The lamp will burn dimly at first, and about 60 to 80 seconds are required before the the thermostat becomes sufficiently warmed up to operate. The period of flashing may be varied by the screw *D*; setting it closer to *A* causes the sign to operate more slowly, while increasing the distance between the two contacts brings about a quicker flashing.

Several thermostats and as many different colored lamps may be placed in one sign, producing a beautiful and ever changing effect. The wiring for three lamps of different colors is shown in Fig. 6. The total cost of material should not be over $4; the sign retails for from $10 to $15.

The official organ of the ministry of commerce and trade in Prussia publishes the following statistics of the trade and technical schools in Prussia at the beginning of 1905: Giving instruction in machine building and other productions of the metal working industries, 19 schools attended by 3055 scholars; architecture and the building trades, 32 schools attended by 5039 scholars; art trades and various high-class crafts, 26 schools and academies attended by 3061 students. Five of the last named schools were State institutions and the other 21 received subventions from the government. These schools had evening and Sunday classes, which were attended by 12,252 students in addition to the number of full course day scholars given. The textile trade schools instructed 1608 males and females, and 237 in the weaving workrooms. There were 1290 technical and 290 commercial finishing schools, with 201,716 and 31,670 scholars respectively, and 428 technical schools, organized and supported by industrial associations or craft guilds, having 28,043 scholars. The State grants subventions to 1237 of the finishing schools.

What is called a heat-proof putty is made by mixing burnt lime with linseed oil and boiling down to the usual consistency of putty and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun. It can be warmed over a lamp or otherwise for use, and on cooling is hard again.

PHOTOGRAPHY.

PHOTOGRAPHING SKIES.

To those who have the faculty of translating color into black and white, the sky is rendered more or less gray, in its monochrome equivalent, and never as white as the paper on which the picture is printed. The color and dependent color value of the blue varies with the direction of the light, the atmosphere and the sun's altitude. Facing the sun the blue is almost effaced; opposite, it is strongest and darkest. It is nearly always lighter at the horizon, but in large towns the effect of dust and vapor may reverse this appearance when the sky is seen over the houses. In Spring, when there is an east wind in this country, the blue has a dryness and opacity that is absent at other periods. In the East there is a depth of blueness that is almost black. All these varying conditions of color, luminosity and gradation have to be represented in black and white by various shades of gray.

BLUE SKY WITH CLOUDS.

The task is somewhat easier where clouds are present. Even in Nature wisps of cirrus and the so-called "mackerel sky" greatly increase the idea of depth and distance. These forms of clouds are really simpler to deal with than the bolder cumulus with their strong shadows and perspective.

RENDERING OF A GRAY SKY.

When we get a gray sky the problem is easier still. It has not the even gradation of the blue sky. The clouds which float across it are usually dark and are not white in the high lights and darker in the shadows than the ground, as is the case with cumulus in a blue sky, and they can be photographed without so much reference to the problems of color. The landscape also is low toned and can be harmonized with less difficulty, most of it being probably lower toned than the sky. There are often instances, however, where the sun shines out brightly after a passing storm, when the landscape, or parts of it, are brilliantly illuminated against a black ground, and are many tones lighter. A good example of this is seen in Francois Millet's April storm effect with rainbow in the Louvre, which has been most effectively reproduced in a photograph. The photograph shows the illuminated portion of the land and woods lighter than the dark sky, as it should be.

THE COLOR VALUE OF BLUE SKY.

It is quite a difficult matter to represent the ethereal blue of the sky by a monochrome process on paper, such as photography, which goes so much beyond mere suggestion. Apart from the technical difficulties of preserving the color value and tones of the landscape objects that meet it, is the task of rendering in some degree the almost unattainable depth and palpitation, as it were, of which we are conscious when looking at it, but which a gray deposit on paper does not at all suggest. We know that a blue sky, as seen opposite the sun, rendered with fairly accurate color relation to the landscape and slight gradation from horizon to zenith, is disappointing in an ordinary platinum print and fails to convey the impression of the original. This is still more marked in the skies of Southern Europe and the East. Have we yet seen Italy, Egypt or India portrayed with the true value of the blue sky in photography? In those countries opposite the sun it may be said with truth to be darker than anything terrestrial save the shadows. Yet if an attempt be made to sun down the sky to the proper value the result will be unnatural, and the landscape appear as if under snow.

PRINTING PROCESS.

The printing process chosen has much influence. One cannot help feeling that the evenly diffused gradation of photography is at fault. The luminousness of the sky is much better shown in mezzotints and etchings than in photographs, where not only are the gradations arbitrary but the surface is broken up. If the photograph deposit be broken up in some way—partly to be achieved by the use of rough paper, by printing through some material, in the case of a plain sky, or by the use of a process such as gum bicarbonate, where a broken up surface can be left by means of a brush—the sky can be kept more nearly approaching its proper value without appearing too opaque.

IMPORTANCE OF CORRECT PRINTING DEPTH.

The depth of printing of a sky, which we have determined upon as correct, cannot be varied without completely changing the character of the picture. Quite a small difference will suffice to spoil the original intention. It is better to err on the side of being too light than too dark. Clouds too heavily printed will seem too near as well as too solid, and lose their vaporous character.—Eustace Calland in the "Practical Photographer."

Films, especially those of a rollable nature, are more difficult to wash than plates. The edges are continually catching in the grooves of the washing tank or else the emulsion surface has a peculiar tendency to rub itself against the sides and bottom of the tank, generally to the detriment of the negative. A satisfactory washing method is as follows: After removing the films from the hypo bath, rinse them quickly in four changes of water, then place them in wash in another tank, changing the water every ten minutes. After the water has been changed eight or nine times, the hypo will be almost entirely eliminated from the films.

THE WIMSHURST MACHINE AND X-RAY WORK.

T. E. ESKIN.

I. The Tubes and Tube Stand.

The questions confronting the beginner in the use of the Wimshurst are so many that perhaps it may be of service to put on record one's experiences, with the hope that they may be useful to others. From the time of Rontgen's great discovery, X-ray work has always been one of my hobbies. At first work was done with a coil giving a 6 in. spark nominally, but really far more. Situated far away from all electric-power stations, the difficulty of getting accumulators charged led to the abandonment of the coil. A friend and myself commenced about two years ago to make experiments with a Wimshurst that had a pair of plates 17 in. diameter, and the results were so good that a larger machine was built. This had six plates, 18 in. diameter, and gave great satisfaction. This was enlarged to twelve plates, and at the present moment is being rebuilt and further enlarged to twenty plates. Needless to say, the various

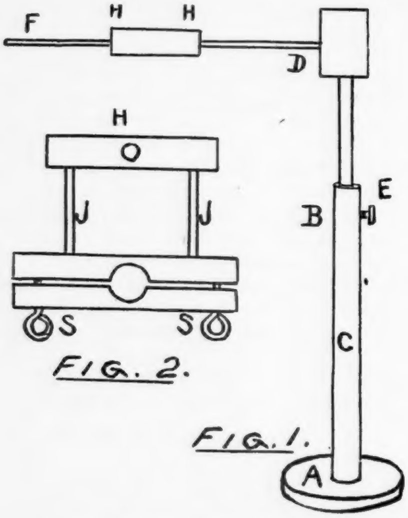


FIG. 2.

FIG. 1.

machines have led to diverse experiences, and misfortunes as well. Perhaps it may be well at the very outset to say that with radiations from an X-ray tube excited by the Wimshurst, I have never yet seen any trouble with dermatitis. There have been cases where exposures have been given for twenty minutes every day for three weeks without the slightest ill effects. The rays which produce the mischief seem closely associated with the hot anticathode, and with a Wimshurst the tube always remains cool. And here perhaps it will be well to say a few words about the kinds of tube.

Of the tubes in use at different times I may mention Brady and Martin's silver medal tube. This is 5½ in. long by 1½ in. diameter, and is fitted with a double anticathode, the one being a simple wire at the end of the tube, the other placed 1 in. from the end and carrying the platinum reflector. This tube did excellent service with the coil and smaller Wimshurst.

Another good tube was Watson's "Penetrator," which has a concave reflector insulated, while the anticathode is formed by a ring between the reflector and the cathode. This gave very brilliant results, but was badly troubled with small sparks outside the tube, which were very dangerous to its life. Covering it with cotton wool somewhat helped to do away with the danger; but it broke down, the disaster occurring at the end of the exhaust. It was re-exhausted, but after some time it broke down again without any warning. Possibly a larger bulb would have prevented this. I lost it with great regret. Other tubes were from time to time tried, but were usually of too flimsy a construction to stand very long. The tube which is undoubtedly the best for all kinds of work is the bianodic tube, and now no other kind is in use. But with static charges, and under conditions to be described hereafter, the interior glass tube which supports the anticathode carrying the heavy platinum reflector is very liable to fracture. This occurred in two tubes, and led to collapse of the reflector. Messrs. Isenthal & Co. have, at my suggestion, grappled with the difficulty, and as I believe, satisfactoriy. The glass interior tube which carries the reflector is blown into a bulb, which fills the recess and entirely prevents collapse of the anticathode, even if a fracture should occur. The difficulty has thus been got over simply and ingeniously and with great credit to them.

A few words may be said about the working of tubes. In contradistinction to the use with a coil, the tube when used with a Wimshurst does not rapidly run up. During a long run, say twenty minutes, it is quite clear that the penetrating power has increased; but there is none of the sticking and flickering which is so tiresome with a coil, and a tube which once works rarely requires warming or doctoring in any way. Occasionally a new tube requires coaxing at first. Because a new tube will not immediately light up it does not follow that it is too high; a quite low tube will sometimes behave in the same way. It would almost seem as if the molecules of glass had to become accustomed to a certain plane of vibration; sometimes merely wiping it

will set it off, at others a careful and judicious warming and, best of all, wrapping it up as far as the cathode in cotton wool. After a time this may be removed and the tube henceforth continue to work well. It may be noted that as a tube does not appreciably run up with the Wimshurst, one which is at all blue will never be got to work satisfactorily.

In close relation to the tube is the subject of the stand for it. It requires to be firm and strong and free from vibration and so constructed that the tube can is easily reversed. The following description of a tube-stand may be useful. *A*, Fig. 1, is a large piece of wood to stand on the floor, carrying an upright post, *AB*, into which *CD* slides, and can be clamped to any height by the clamp *E*. *D* is a small block of wood into which a stout piece of glass rod or tubing ⅜ in. thickness is firmly inserted. On this a piece of glass tubing, *HH* slides freely. This passes through a piece of wood *H* at Fig. 2, which is 10 x 2½ x 1 in. Immediately below is a second piece somewhat smaller, divided into two. Through this the tube passes at *T*, and by the two wooden screws *SS* it is held firmly in its place. The upper and lower pieces of wood are connected by four stout strips of ebonite, 7 in. long, two of which are shown at *J*. The top and bottom of the aperture *T* is padded, and the tube can easily be turned round so that the anticathode can point either up, down or sideways. The carrier *HH* allows it to be moved over the patient to the required spot, while the necessary height is regulated by the clamp at *E*. Should it be necessary to reverse the tube, the connecting wires are unhooked and the carrier *HH* put on the other way, which can be done almost instantty. The stand being on the floor, is much freer from vibration, and the connections are all out of the way. Further, the insulation is perfect and no loss of electricity is sustained, and the tube is out of danger.—" English Mechanic."

CONTINUED IN DECEMBER.

ELECTRIC BATTERIES; THEIR CONSTRUCTION AND USES.

FREDERICK A. DRAPER.

III. Internal and External Resistance—Grouping of Cells.

Before taking up the construction of different types of batteries, it will be well to understand how best to group cells to secure the most efficient service from them, as such information will be of value in helping to determine the kind of cell to use for any particular work. The several factors to be considered in selecting cells are, the relative constancy, the electro-motive force and the ratio between the internal resistance of the cell and the external circuit. The matter of E. M. F. and constancy have already been briefly noted. The internal resistance of a cell, in its relation to the external circuit, is an important matter.

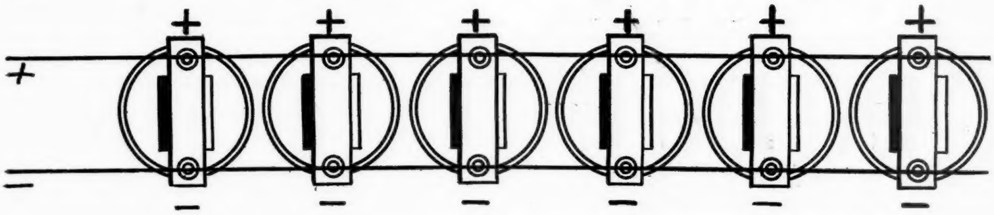


Fig. 1.

By " internal resistance " is meant the resistance to the passage of the current offered by the exciting fluid. In the so-called " dry " cells, the liquid is held by absorbent material, which in a moist state is in contact with the elements. The internal resistance is expressed in formulas as *r*. The external resistance, expressed as *R*, includes the conducting wires, instruments, lamps, etc., through which the current passes from and returning to the cell. The formula which expresses to the relations existing between the E. M. F., and internal resistance of a cell, the resistance in the external circuit, and the current developed is

$$\frac{E}{R + r} = C,$$

in which E is the E. M. F. in volts; R the external resistance, *r* the internal resistance and *C* the current in amperes.

As the elements used in a cell determines the E. M. F. it is evident that the matter of size has no influence upon the difference of potential between the poles or voltage. On the other hand, the size has much to do with the current from a cell, or amperage. This is because the larger the plates the less the proportion ate external resistance. If plates measuring 2 x 2 in in a cell having an E. M. F. of 1 volt and so located that the internal resistance is ½ ohm, are replaced by

plates 2 x 4 in., the resistance is reduced one-half, or to ½ ohm, and the resulting current is doubled. The two examples would figure as follows:

$$1,\ \frac{1}{\frac{1}{2}} = 2;\quad 2,\ \frac{1}{\frac{1}{2}} = 4.$$

As a substitute for making cells of large and inconvenient size, groups of small cells may be so connected that the current obtainable will be equivalent to that from one or more large ones. This is known as multiple or parallel connection and is illustrated in Fig. 1. Here six cells are so connected that all the elements of one kind (zinc) are on one part of the circuit and the other (carbon) on the other part, the resistance of the

$$\frac{E\,1.4 \times 6}{r\,1 \times 6} = 1.4 \text{ amperes.}$$

We have seen how the E. M. F. or current can be altered at will; we will now consider the important bearing this has in relation to the resistance of the external circuit. Assume that an external circuit has a resistance of 1 ohm, that the battery has an E. M. F. of 1.4 volts and an internal resistance of 1 ohm, this would give

$$\frac{E\,1.4}{R1 + r1} = .7 \text{ amperes.}$$

If the external circuit has a resistance of 1000 ohms, one cell would give

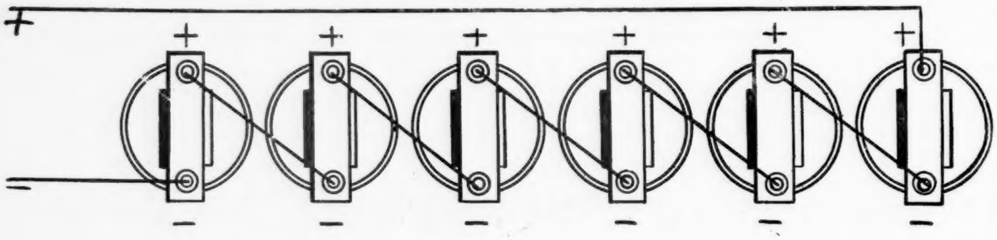


Fig. 2.

connecting wires being negligable. If each of these cells had an E. M. F. of 1.4 volts and an internal resistance of 1 ohm, the formula for the group as above connected would be:

$$\frac{E\,1.4}{O\,1} = 1.4 \times 6 = 8.4 \text{ amperes.}$$

If, however, we desired to increase the E. M. F., the cells would be connected as shown in Fig. 2, known as "series" connection, where the positive pole of one cell is connected to the negative pole of the next, which has the effect of adding the E. M. F. of the cells

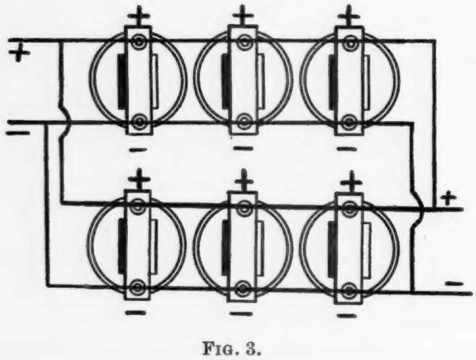


Fig. 3.

so connected. But as the resistance of each cell is interposed to the passage of the current, the amperes remain the same as for one cell. Assuming the E. M. F. and internal resistanee to be the same as for the previous illustration, this is shown as follows: $E\,1.4 \times 6 =$ 8.4 volts and

$$\frac{E\,1.4}{R1000 + r1} = .001368 \text{ amperes.}$$

With 10 cells the current would be

$$\frac{E\,1.4 \times 10}{R1000 + r10} = .01386 \text{ amperes.}$$

and with 100 cells

$$\frac{E\,1.4 \times 100}{R1000 + r100} = .1273 \text{ amperes.}$$

showing that the current increases at nearly the same rate as does the number of cells. Should the cell be of a type having a high internal resistance, the result of increasing the number of cells in series is found to be quite different. The type of battery universally used on long distance telegraph work has an internal resistance of about 4 ohms, and has an E. M. F. of about .9 volts per cell. In an external circuit of 1 ohm resistance the current from 1 cell would be

$$\frac{E\,.9}{R1 + r4} = 1.3 \text{ amperes.}$$

and ten cells would give

$$\frac{E\,.9 \times 10}{R1 + r40} = 2.2 \text{ amperes.}$$

From 100 cells we would get

$$\frac{E\,.9 \times 100}{R1 + r400} = .224 \text{ amperes.}$$

showing plainly that with a low external resistance nothing is gained by increasing the number of cells where the internal resistence is high, and also that the excess above a certain number caused a positive loss.

If the resistance in the external circuit be high, as in long telegraph lines, high resistance in a battery is not so objectionable, if other advantages are obtained, as will be seen by the following, assuming an external resistance of 1000 ohms. With one cell we would get

$$\frac{E.9}{R1000 + r4} = .000896 \text{ amperes.}$$

With 10 cells we would get

$$\frac{E.9 \times 10}{R1000 + r40} = .00865 \text{ amperes.}$$

and 100 cells would give

$$\frac{E.9 \times 100}{R1000 + r400} = .0643 \text{ amperes.}$$

The several illustrations here given should enable the reader to calculate the results which any given combination of cells would give, the E. M. F. and external and internal resistance being known. It would be found that the best possible arrangement for circuits of low external resistance to give the maximum of current is where the grouping is such as to make the internal resistance equal to the external resistance. But no arrangment is economical unless the external resistance considerably exceeds the internal. Hence in induction coils, the use of comparatively small wire for the primary winding, when batteries are used for current, the higher resistance of the finer wire retarding the flow of the current.

Another method of grouping cells shown in Fig. 3 partakes in part of the arrangements previously shown and is known as "series-parallel". Combinations of this kind enable both the E. M. F. and current to be increased or varied as desired, the parts connected in series raising the volts, and the joining of these series groups increasing the current. This style of grouping is of value in exciting the coils for sparking gas engines, and other purposes where a strong, snappy current is required for steady work.

"WIRELESS" RECEIVING STATION.

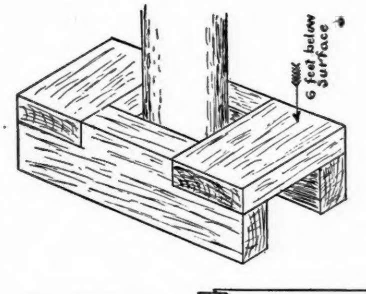
OSCAR N. DAME.

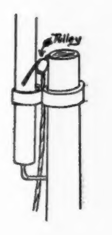
In constructing a receiving outfit, the same aerial and ground is used, and provision is made by a jack-knife switch by which the aerial may be shifted from receiving to sending at will. A synchronizing coil similar to the one described in the October number is also constructed, with three connecting clips for attaching portions of apparatus to the coils. The lower end of this coil is permanently grounded, and the upper end is connected to one side of the coherer. The other side of the coherer goes to the coherer battery, whence continues the circuit through the windings of the relay back to the lower end of the coil where the ground connection is made.

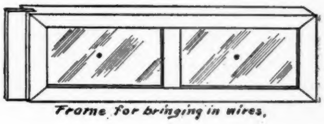
For the protection of the delicate apparatus in use, there is placed in parallel across this circuit, a lightning spark gap, designed to carry foreign discharges direct to ground, should they enter on the aerial. The sounder and decoherer are connected to the relay, as in the sketch here shown.

In selecting a pole for the aerial wire, the locality in which one lives plays an important part. In many sections of the country it is an easy matter to procure straight poles with eight inch butts and four inch tops, 60 feet long, or longer, but in other States the best that can be procured is the shorter Cananian spruce poles, averaging 30 feet in length. These may be procured in all diameters in nearly all cities in the North and East for about \$3 each at the yards, and smaller poles for the topmast for about \$2. In this way a 50 foot pole may be had for \$5, including such small iron work as a blacksmith would provide for stepping the topmast. Such a pole sould be set in the ground fully five feet and braced a few inches below the earth's surface by logs or timber butts placed crossways about the pole and bolted together. This bracing adds greatly to the endurance of the pole in stormy weather.

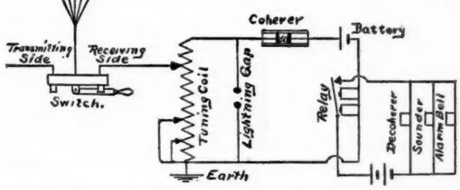
The question might be asked: "With a certain height of pole, how far may one receive and send?" To this it is difficult to reply with any degree of accuracy, a great deal depending on the apparatus in use. It is absolutely certain that such a pole will suffice for picking up messages from commercial stations located







Frame for bringing in wires.



even twenty miles away, and will, with a 2-inch coil transmit across a township and possibly 10 miles, provided atmospheric conditions were favorable. But it must be fully appreciated that sensitive receiving de-

vices are necessary for this distance, and it is the writer's opinion that no home constructed receiving device will be found available for such a distance as 10 miles unless constructed with great skill and accuracy, while on the other hand, the ordinary glass tubs coherer may be found sufficiently accurate up to 3 or 4 miles.

There are places in this country where the purchase of a Canada tree is out or the question, and in such places recourse may generally be had to saw-mill and lumber yards. Spruce sticks 6 x 6 in. and 30 ft. long make a very creditable mast if tapered on four sides by means of the rip saw at the mill. A top-mast of the spruce 4 x 4 in. and likewise tapered is easily prepared, but both mast and topmast should be made of selected wood free from knots and flaws, for a cut timber is inferior to a natural stick for flagpole purposes owing to its lack of flexibility.

In connecting topmast to mast it is desirable to provide means of lowering the mast during stormy weather, especially if the stick is of small diameter. It is customary to have a ring permanently fastened to the mast at the top, through which the topmast is drawn by means of halyards, the but of the topmast finally being set in position on a pin, as shown in Fig. 2. With ordinary poles of less than 55 ft. height, this may be dispensed with, as the topmast may be easily lifted into place by one man with the aid of a ladder.

Aerial wires should terminate in an insulated knob of glass so as to be readily attached to and drawn up by the halyards. This permits raising and lowering a cage or other device designed to improve the receiving and sending efficiency.

In designing a cage for experimental work it is best to have the cage length just one-fourth the extreme length of the aerial wire. The main wire should be No. 14 or No. 16 bare copper. Iron wire may be used where copper wire is obtainable only at considerable cost.

In bringing aerial wire into the instrument room, it is advisable to provide a better insulation than would be had with a porcelain tube inserted in the wall. The writer has seen a small round hole drilled in the glass pane of the window, for the entering wire. A convenient way to arrange this would be to construct a wooden framework sash of sufficient height to take 4 x 5 or 5 x 7 glass plates (old photo negatives will prove very useful for this purpose), and a hole drilled in one pane for the aerial wire. Should it be desirable to bring the ground wire in through this frame, the second hole should be drilled as far as possible from the first, to insure insulation. As the length of the aerial is measured from the coil to the peak of the wave cage it is desirable to have the wire run direct to the instrument room without any bends and with as few loops as possible. The wire should not be permitted to rest on trees or any part of the building, or on the pole by which it is raised.

A small brass or galvanized iron pulley is fastened by a staple or screw eye to the top, for the halyards. The aerial wire may consist of any of the various forms of cages or fans calculated to assist in sending or receiving, or may be a single wire fitted with a glass or porcelain insulator to which the halyards are made fast.

NEW METHOD OF MINING COAL.

Consul-General Holloway, of Halifax, reports that the Dominion Coal Company, Glace Bay, Nova Scotia, is testing a machine intended to take the place of explosives. It is a hydraulic cartridge, said to be successful in Great Britain. At present coal is blown down with powder after the undercutting is completed. In the use of the cartridge, after the undercutting and shearing are finished, a hole of 3½ inches in diameter is bored in the coal parallel with the roof, wherein the cartridge is inserted. A piston operates at one end and a pump at the other. This forces the water along a tube until it comes in contact with the first piston and pushes it out. The pressure becomes general on all pistons, which commence to penetrate the coal in a downward direction. The pistons are set very close, there being scarcely half an inch between them. As the pressure increases the coal gradually leaves the roof and falls to the floor in the best salable condition. When the powder is used in blowing down coal there is considerable waste through breakage into dust and slack. It is claimed that this element of waste is greatly eliminated by the use of the cartridge, and 40 per cent more salable coal is produced than by the ordinary methods of mining. The weight of the entire apparatus is 44 pounds. One man can operate it. The amount of water required is from a pint to a quart, according to the pressure needed to bring down the coal. The water is stored in a little resevoir attached to a pipe, and runs to the bottom of the pump. The machine is supposed to be especially serviceable in long wall and pillar work.

Development of the internal combustion engine for marine purpose means that, in the adoption of the now familiar motor boat, the same ranges of power and action as are obtained by the best reciprocating engines and boilers can be secured at one-sixth of the weight with the new motor. The British Admiralty are so convinced of the advantages of the combustion engine that they have carried out at sea a series of experiments, and there is some talk of utilizing this type of engine in the new torpedo boats which are about to be built.

To doubt and be astonished is to recognize our ignorance, and this is the first step toward acquiring knowledge.—Lord Chesterfield.

ELECTRICAL PROTECTIVE DEVICES.

ARTHUR H. BELL.

Aerial lines of telegraph companies were the first wires requiring lighting and foreign current protection. Long pole lines, stretching far out into the country, rarely escape injury during severe tempests, the heavy potential sweeping into the station, destroying instrument coils, and often shocking the operators and occasionally setting fire to the office. It was found that the oscillating lightning current sought first of all, a ground jump from wire to wire and instrument to instrument.

The first step toward protection, therefore, consisted of a triangular device, similar to the illustration, Fig. 1. The peg seen in the cut is metallic, and may be used to connect one side of the line directly across to the ground; in other words, is grounding that side of the line to which it is pegged. The middle wire of the trio is connected to a large plate of metal or coil of wire buried in moist earth. The two other wires are entering wires, and the lower pair the instrument wire.

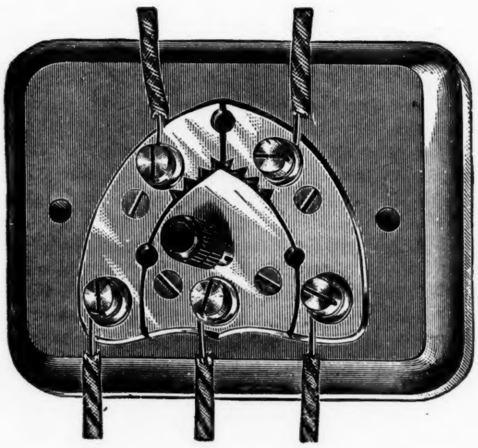


FIG. 1.

Should lightning strike along the line and enter the building, it was presumed that the foreign currents would leap across to the shield-shaped center piece and reach the ground instantly, but experience showed that high potentials often evaded the ground and continued to the instrument table.

Not, however, till the arrival of the telephone, was the serious side of lightning dealt with to any extent. The form of arrester shown in Fig. 1 was also on the first telephone instruments, being placed on top of the bell box at the binding posts. The entering wire is in reality a lead wire, which is drawn to a diameter calculated to melt and part at a certain maximum current. All wire possesses a conductivity proportionate to its area or section, and the thinner the wire the less current it will carry safely. Fuses, therefore, are designed along the lines of Fig. 2, being inserted in a cut in the line wire. It is desirable to use two fuses, one on each wire. In Fig. 2 the lead fuse wire is stuck to a mica strip, with shellac.

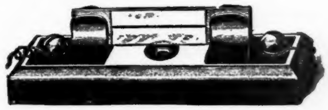


FIG. 2.

It was found, however, that enormous potentials passed through small fuses without "blowing" them, because voltage is not a heating factor like amperage, and provisions had to be made to side-track the heavy voltage before it reached the instrument.

A device known as the carbon block arrestor, came next into use for this purpose. In Fig. 3 the left-hand binding post is connected to the ground wire and is in itself in contact with the left hand of the two carbon blocks. Between this block and the right-hand one which it appears to touch, is a thin wafer of mica, oiled silk or tough paper, insulating one carbon from the other by a space of .0005 in., or so. The right-hand block connects with the fuse and with the instrument. The other end of the fuse goes into the line wire. It will be seen that ordinary currents pass in through the

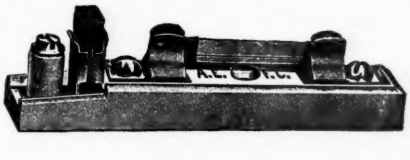


FIG. 3.

fuse to the instrument, and the carbon block operates only when a potential sufficient to leap the carbon gap passes in. The further apart the blocks the greater potential needed to break down the air space. In this way the protector protects from electric light and power circuits the fuse from blowing and the block arcing. It is desirable to place wooden, asbestos lined or porcelain covers over the fuses and the carbons, to protect the premises from fire. Oftentimes the fuses come in glass tubes, and recently the fiber-covered tube has come into popularity.

In telephone practice there are hundreds of devices, designed by the engineers for certain duty. Some are similar to those just described and some are self soldering, that is after blowing, restore themselves to normal condition. The principle involved is the relation of current to time, a certain amount of excessive current passing through insulated resistance wound on a brass spool, heats a metal pin soldered with soft solder in the spool and opens the circuit as long as the excessive current prevails.

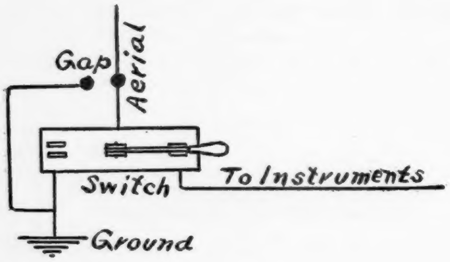


FIG 4.

In wireless telegraphy the aerial wire is elevated to a height of from 50 to 200 feet, and gathers at all times from the atmosphere a certain amount of high tension even on cloudless days. Such tension cannot be readily dispersed, and in most stations the chattering of the sensitive relay shows its action at times to be quite vigorous, in fact it is only recently in actual wireless practice that scientists have appreciated that there are cloudless days when, should it suddenly become dark the atmosphere would be streaked with flashes of heat (?) lightning, as on a Summer's night.

To protect wireless stations it is advisable to connect a spark gap, as in Fig. 4, one side to the aerial wire and the other to the ground whenever there is a tempest, and also throw open the knife switch used for connecting the aerial with instruments. It is most advisable to have a knife switch of the two-way type on the outside of the building, connecting the aerial to the knife blade, the station wire to one post and the ground to the other. Prompt grounding of this aerial insures absolute protection to instruments and the operator.

WHY STEEL CAN BE CUT FASTER THAN IRON.

Arthur H. Corby, before the Sanford Science Students Asso.

With all the tool steels working on steel at high speeds, the continual rubbing of the shaving on the upper surface of the tool wears more or less of a pit on the surface. At the same time, on the extreme point of the tool a small accumulation of portions of the material being cut gathers, being practically welded to the tool. Now, the position of the pit on the upper surface of the tool is situated further back from the cutting edge with a deep cut than with a light one. This is owing to the tenacity of the steel, and is not found to be the case in turning cast iron. The tenacity of the shaving and the action of the tool as a wedge cause the actual point of leverage to be in advance of the extreme edge of the tool. The larger the chip the greater its strength is, and therefore the further back on the tool it slides, making a greater angle between the shaving and the work wherein the front of the tool is more or less clear. The tool splits off the shaving of material like an axe cleaving wood with the grain. After having once entered, the cutting edge of the axe is clear, while the thicker part of the axe, like a wedge, forces the wood apart. In my opinion, the action of the tool in cutting steel is similar, and with the larger cuts the greater part of the work is done well back on the tool, where there is a good body of steel. In a lighter cut the shaving wears a pit right up to the cutting edge, thereby weakening it, and causing it to break down sooner. With cast iron, owing to its brittleness, the action is different, and the work is practically all concentrated on the cutting edge. When the tool first penetrates a piece of iron is broken off for a little distance in advance of teh too; the roughness intervening is removed as the work revolves against the tool, the point of which again penetrates and breaks off a portion, and so the action continues.

A curious fact has recently been brought to light, namely, that a man's mind is so constituted that it cannot work normally in a circular room. The discovery was made in connection with Minot Ledge lighthouse, which is a piece of engineering of the highest order. The tower being circular, space is in great demand and, accordingly, everything is made to conform to the shape. The beds are circular, the tables and benches are half-moons. There have been five well marked cases of insanity in the men who have worked here, and a number of others have been removed before their minds become entirely unbalanced. On being placed in rooms having the ordinary number of angles and corners, the sufferers rapidly improved and the theory has been propounded that the shape of the lighthouse rooms is responsible for the trouble. Experts in mental diseases have made a study of the conditions existing at Minot Ledge, and they say that there is no point on which the eye may rest, so that it travels around and around until the result becomes maddening.

Radium acts upon the chemical constituents of glass porcelain and paper, imparting to them a violet tinge, changes white phosphorus to yellow, oxygen to ozone, affects photograph plates and produces many other curious chemical changes.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

VII. Boring Cylinders on Face-plate.

In the last chapter, the boring of a cylinder that could be clamped to the carriage was considered. It is not always possible, however, to clamp some shapes to the carriage and it becomes necessary to fasten the piece to the face plate and bore with a tool held in the tool-post. This method, of course, introduces considerable overhang, and many problems of proper support for the overhanging end present themselves. We shall consider the case of boring a cylinder on the face plate with an overhang of some 11 inches.

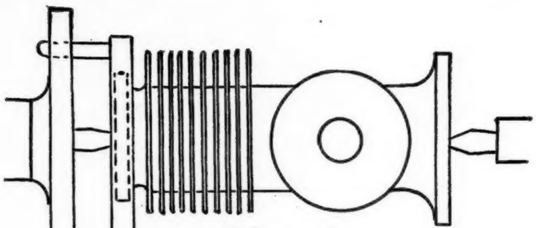
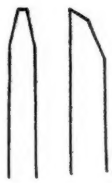


Fig. 1.



Tool

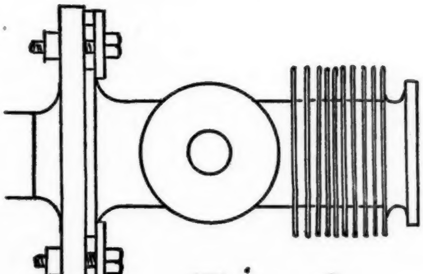


Fig. 2.

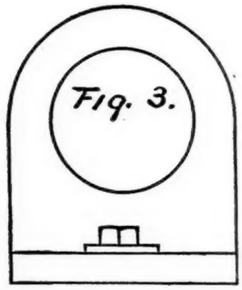


Fig. 3.

One end is first squared by placing on center and facing as shown in Fig. 1. Then the piece having had one true surface upon which it may rest provided, it is turned end for end and the piece clamped against the face plate, as shown in Fig. 2.

This leaves the opposite end unsupported, and when the tool takes hold chattering will commence, owing to the spring. This effect is taken care of by providing a temporary support for the outer end made of a piece of hard wood, Fig. 3, similar in shape to the steady rest and having the aperture lined with a piece of sheet iron or steel to take the wear. When such a rest is provided, a turned section should be made on the overhanging end so that it will run in perfect truth. This may best be done while supported on the centers. Then, when the casting has been firmly clamped to the face plate and the steady rest adjusted, the boring may be done. The center bridges, which are usually cast in castings for facing the ends, are knocked out after the outer end is finished.

The inside of the cylinder is always rough and uneven, so that a very light cut is all that can be taken at first until the tool gets under the scale. Here again enters the problem of proper tool support, because when the tool is working at the extreme inside of the cylinder it has considerable overhang and the pressure of the work is very apt to spring the tool considerably. This may be prevented to a great extent by having a boring tool similar to the one shown in the December, '04 issue of AMATEUR WORK. The bar may be much heavier and will perform the work with far less chattering.

The final or finishing cut is made very fine and the end of the tool should be flat and about 1-16 in. wide, having a feed of less than 1-16 in. per turn. This should give a very smooth finishing cut, but the speed of the cut must not be too high.

It is somewhat difficult to bore a perfectly straight

hole with this kind of a tool without several re-cuts; this is not always due to an error in the ways, but many other causes enter into the results which often make it quite troublesome. The spring of the overhanging end is largely responsible for it, which spring gradually decreases as the cut approaches the supported end. A recess in the inner wall, such as a port, will often cause considerable difficulty, but slow feeding and a light cut will usually overcome all such obstacles.

HOW TO MAKE A PANTAGRAPH.

To those who possess but little drawing ability a pantograph will be found of the utmost service for enlarging and transferring copies of designs from paper on to wood, such as is required for fretwork or inlaid work. The use of the apparatus will be understood from an examination of Fig. 1, which shows the apparatus complete.

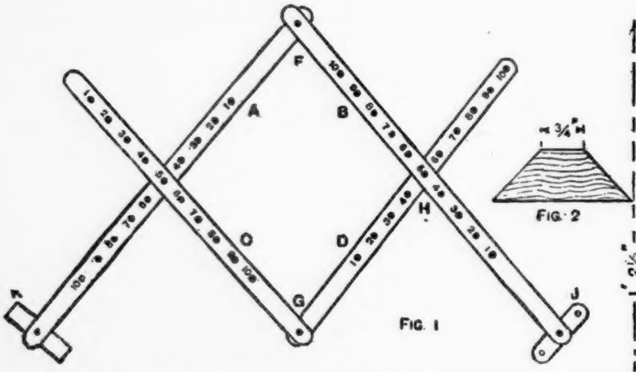


FIG. 1

FIG. 2

FIG 3

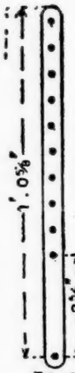


FIG. 4

FIG. 5

This instrument is made almost entirely of wood. It consists of four perforated wooden limbs or rules *A*, *B*, *C* and *D*, and a block *E*. These limbs are arranged in pairs and jointed together at the crossing, the two crossings being jointed together at *F* and *G*. The perforations are made at uniform distances, in accordance with the scale of measurement. The pivoted joints by which the top pairs are connected are constant, while the joints between the two intersecting limbs of each pair may be shifted by inserting the joint pins *H* in different holes in each limb. By thus changing the pins the body may be reproduced in any scale, either larger or smaller than the original, or it may be drawn the same size.

In constructing, first make the block *E* from a piece of wood ½ in. thick, ⅝ in. wide and 2¼ in. long to the shape of Fig. 2. Now cut the two limbs or strips *A* and *B*, Fig. 1, both 1 ft. 3¼ in. long, similar to Fig 3. At *J* drill a ¼-in. hole for the pencil to fit; at the other end of the limb *B* drill a 1-16 in. hole; these holes must be 1 ft. 2½ in. apart from center to center. The limb *A* must be similarly drilled with a 1-16 in. hole at each end. Now cut the other two limbs for *C* and *D* 1 ft. ⅝ in. long, and ⅜ in. from the end of each drill a ⅛-in. hole for the tracing point, which can be made with a wire nail 1 in. long. When this is inserted one pair of limbs will be complete; the other pair are coupled in a similar manner. Each limb is ⅝ in. wide and 3-16 in. thick, and shown separate in Figs. 4 and 5; the perforations are shown in the illustration; each hole is ⅞ in. apart. The coupling pins are made from very fine screws. It will be convenient to mark the perforations as shown in Fig. 1.

When a copy is to be made the corresponding numbers on the limbs are put together. In use the end pivot *K* is placed in the block *E*, the pivot *F* sliding on the plane surface of the table according to the impulse given to it, then end hole *J* carrying the pencil, and the coupling of the two limbs *C* and *D* carrying the tracing point *G*. Lines traced by *G* will also be drawn by *J* on a larger scale, corresponding to the adjustment. If the copy is to be reduced, the tracing point is placed at *J* and the pencil at *G*. With the fingers of one hand on the tracing point, move it carefully over the design; at the same time with the other hand apply just sufficient pressure to the pencil to cause it to make its mark as it travels over the paper. All drawings can afterwards be shaded as desired.—"Work," London.

In the casting of brass the pattern should be slightly larger to insure the proper dimensions. The shrinkage allowance on patterns for casting brass is 3-16 inch to the foot in length or diameter of the pattern.

AMERICAN SOCIETY OF MODEL MAKERS.

Organization of the Society Under Way.

The many responses from all sections of the country to the suggestion in the October number regarding the forming of an "American Society of Model Makers" shows the interest to be even greater than was anticipated. Many of the letters would be interesting to our readers, but space will not permit of their being published. They contain suggestions which will be of much value in the work of organizing the society, which, it can now be deffinitely stated, will be given immediate attention. In all probability the society will be incorporated under the special laws of Massachusets, which are very favorable for societies of an educational character.

The membership will, at first, probably be general, but as soon as a sufficient number from any one locality have shown their desire, a local branch will be installed. The replies are already sufficiently numerous to indicate that branches can be successfully established in Boston, New York, Philadelphia, Chicago, San Francisco, and other centers will soon have the required number.

As previously indicated, the general object of the society will be for mutual education and self-help. As suggested by several, this could also include the securing of supplies, the general utilizing of patterns for machines, engines, tools, etc., and the exchange of same. Many other ways in which the society can be helpful will readily occur to readers. It is hoped that the preliminary work of organizing will be completed in time to give details in the December issue. In the meantime, any readers who are interested in such a society but who have not yet advised of their intention of joining, are invited to do so that no time may be lost in organizing branches.

BOOKS RECEIVED.

How to Draw. Leon Barritt. 107 pp. 9 x 12 in. Numerous illustrations. Harper & Bros., New York. Price $2.00

The basic principles of illustration are set forth in this book in a simple, practical way, thus making it an excellent guide for the beginner who wishes to give special attention to the field covered by the book. Instructions for drawing the head, eye, ear, mouth, hand, feet, and the entire human figure are given, with suitable examples. The work then advances to studies from life, including children and animals: also landscape, together with various methods of work, followed by many plates of examples of the work of leading illustrators. The student will find much of value, especially anyone without the guidance of a teacher, for whom the book was especially written.

Foundry Practice. James M. Tate and Melvin O. Stone, M. E. 336 pp. 7¾ x 5 in. 111 illustrations. The H. W. Wilson Co. Minneapolis, Minn. Price $1.50. Supplied by Amateur Work.

In the preparation of this book the author had in mind the special needs of the student and beginner in the work. As both writers are of the staff of the University of Minnesota, they have had ample opportunity to learn what is required for a book of the kind, and have most excellently met that demand. To this end numerous examples are given representative of the different kinds of molding, with suitable illustrations to supplement the text. This should also be a valuable help to pattern-makers, as a working knowledge of foundry practice on the part of those making the patterns would undoubtedly result in a better construction of patterns than is frequently met with.

SCIENCE AND INDUSTRY.

The substitution of oil for water in cooling cylinders of gasoline engines does away with any risk of damage to the engine by freezing and expansion of the water jacket. Small engines can be cooled with oil by replacing the water tank with an ordinary hot-water heat radiator. For engines of medium size a special radiator is used in the form of a vertical boiler containing small tubes open at both ends. The top of the boiler is covered by a cone and short stack into which the exhaust from the engine is conducted to induce a draft through the tubing. The hot oil is fed into the top of the boiler and the cooled oil drawn off at the bottom to circulate back through the jacket of the engine. Large engines require the addition of a small centrifugal pump to keep the oil circulating rapidly. This form of cooler has been successfully applied to engines of over 40 h. p. It cannot freeze, requires no attention, and works well under any climatic conditions. The tank, connections and jackets are sealed air tight, so that no waste of the oil can take place, and the original supply will last as long as the engine.

The fourth jewel screw of almost any of the standard American makes of watches is so small that to the naked eye it looks like a mere speck of metal. It must necessarily be perfect in all respects. When examined under a powerful microscope it is seen that the threads averaged 260 to the inch. It is exactly four one-hundredths of an inch in diameter and over 50,000 could be packed into a lady's thimble with ease. Counting these screws is never attempted, of course, but 100 are weighed on a delicate steelyard and the total number of an output is arrived at by comparing the gross weight with the weight of these. Such tiny screws can only be made in large numbers by machinery, and the operation attending their manufacture is one of the most delicate things in watchmaking.

In boring cylinders it is better to use three cutters than one. With one cutter there is spring to the bar. With two the bar is less well supported than with three. One cutter will cause the hole to be smaller in the middle than at the ends of the cylinder, and the surface of the metal will be rougher in the middle than at the ends of the cylinder.

A boy of 17 is not too young to enter an engineering school, though he could better grasp the requirements of the course were he a year older. It is not the most brilliant or showy student that always makes the best engineer, the chap who has to "dig" and acquire knowledge slowly often developing into the most trustworthy engineer. In its commercial application engineering is the art of making a dollar earn the most interest.

Rocking stones, as they are called, have come into the positions in which they are found usually by one of three methods. Either the stones are practically in situ, and the surrounding rock having been removed by natural decay and disintegration, leaving the stone so peculiarly balanced that it may be readily moved by pressure and caused to rock to and fro; or the rock has fallen from some higher elevation, and some of the stones helping to support it in its new position have disintegrated and disappeared, or the rock has been carried to its present position by ice. All three of these conditions are found, and possibly some others. Some rocking stones weigh many tons.

The young man who, after making up his mind what he wants to do in the world, begins to hunt up obstacles in his path, to magnify them, to brood over them until they become mountains and then to wait for new ones to develop, is not a man to take hold of great enterprises. The man who stops to weigh and consider every possible danger or objections never amounts to anything. He is a small man made for little things. He walks around an obstacle and goes as far as he can easily, but when the going gets hard he stops.

The strong man, the positive, decisive soul who is determined to carry it out, cuts his way to his goal regardless of difficulties. It is the wobbler, the weak-kneed man, the discouraged man, who turns aside, who takes a crooked path to his goal. Men who achieve things, who get things done, do not spend time haggling over perplexities or wondering whether they can overcome them. A penny held close to the eye shuts out the sun. When a man lies down on the ground to see what is ahead of him a rock may hide a mountain. A small man holds petty difficulties so closely in view that great objects beyond are entirely shut out of sight. Great minds keep their minds on the goal. They hold the end so persistently in view and it looks so grand and desirable that the intermediate steps, no matter how perplexing, are of comparatively little importance. The great man asks but one question: "Can the thing be done?" not "How many difficulties will I run across?" If it is within the reach of possibility all hindrances must be pushed aside.

Influenza has been for some time past very prevalent in Germany, says Richard Guenther, Consul-General, Frankfort, Germany, extending to horses, which are in some instances, quarantined. The Frankfort "News" states that in 1890, when influenza was epidemic throughout Europe, many workmen contracted the disease in three watch factories at Madretsch, and a number died. At one factory at Madretsch, however, the disease did not appear. Investigations showed that oil of turpentine was used in the turning of the metals used for watch cases, and the oil becoming warm, evaporated and the workmen inhaled the air laden with it. This seemed to protect them against the disease. Since then oil of turpentine has been always evaporated in that factory upon a stove, and not a case of influenza has ever occurred there. This preventive measure is successfully employed in dwellings, and the inhaling of water vapor with oil of turpentine is said to act favorably on the affected respiratory organs.

As disagreeable experiences are had at the mints from time to time with brittle gold alloys, the subject has again been taken up by chemists. Tests have confirmed the fact that lead, iron and tellurium must be avoided, as they act injuriously upon the properties of gold, even in the smallest quantities.

At the Paris mint the first specific investigations concerning this important question were conducted. In 1868 the director of that mint caused elaborate experiments to be made in order to learn what other metal besides silver and copper could be responsible for a deterioration of gold. Brittle coins were collected and their chemical composition was accurately ascertained. It was found that silver and copper are much less deleterious than lead and iron. In some brittle gold coins only one-fifth of 1 per cent of lead or iron was found, but these quantities were sufficient to impair the malleability of the gold.

When a splinter has been driven into the hand it can be extracted by steam. Fill a wide-mouthed bottle nearly full of hot water, place the injured part over the mouth and press it slightly. The suction thus produced will draw the flesh down, and in a minute or two the steam will extract the splinter, also the inflammation.—"National Magazine."

In hard soldering, or brazing with borax, there are one or two little points which cause trouble. The salt forms large bubbles in contact with the soldering iron and easily scales away from the surface of the parts to be soldered. Then, too, the parts must be cleaned each time before applying the borax. Instead of borax use boric acid and sodium carbonate, of which borax is made, and these troubles disappear. The heat of the iron combines them in such a way as to make an excellent flux—free from the difficulties experienced with borax.